CYSTS OF THE JAWS

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A report submitted in part for the
Degree of Master of Science in Dental Radiology
at the University of London.

August 1993

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to the following:

Professor N. J. D. Smith for his support throughout the preparation of this report, and his guidance and tuition during the entire course.

Professor J. M. Portelli, Dean, Faculty of Dental Surgery and Professor G. E. Camilleri, Head of the Department of Oral Medicine, Surgery and Pathology, University of Malta for their encouragement to further my studies.

Professor H. Galea, Director of Dental Surgery and Professor M. Cauchi, Director of Pathology for access to material.

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Chapter 1

Historical Aspect

HISTORICAL ASPECT

Cysts of the jaws are not lesions that are confined to modern times. Studies on the palaeopathology of ancient Egypt by Ruffer[1] described lesions in the jaws of three mummified specimens which appear to be radicular cysts. Two of them are from a predynastic era, Naga el Deir (circa 4500 BC). One of them shows a root remnant in the right second premolar region of the maxilla with a cavity in the bone at its apex.

The second specimen shows a cystic lesion in the bone of the lower first permanent molar. The third specimen is from Cleopatra's period, Ras el Tin, and shows an oval opening with smooth borders measuring 12 by 8 mm in the outer wall of the alveolar bone in the premolar region.

Another study on ancient Egyptian skulls and mandibles was made by Salama and Hilmy[2]; They reported on two pathological cavities found in two specimens from a collection of skulls excavated at Sakara; belonging to the period of King Unas of the fifth dynasty circa 2800BC. One in an adult skull, shows a large radicular cyst in relation to the maxillary left canine and premolar. The second specimen shows a large multilocular cyst in the left body of an edentulous mandible. There is expansion of both inner and outer plates of bone, the cystic expansion involving the ascending ramus and including the coronoid process.

Celcus in the early part of the first century AD, described the possible causes and the treatment of what may be a radicular cyst. He is quoted by Lufkin[3]:

> "It also happens, that from an ulcer of the gums ... one may have for a long period a discharge of pus on account of a broken or rotten tooth, or else on account of a disease of the bone; in this case there often exists a fistula.
>
> Then the latter must be opened, the tooth extracted and if any bony fragment exist, this should be removed; and if there be anything else diseased, this should be scraped away".

Neiburger[4] has described a cystic lesion in the angle of a mandible excavated from a burial mound (Dodge County, Wisconsin) of the middle Woodland cultural period, 7000 to 1100 AD. The lesion found in the right mandible of a 24- to 38- year old female American Indian is located in the lower third of the mandible below the erupted third molar. A radiograph shows a 'multicystic' defect. Neiburger suggested a diagnosis of 'multilocular cyst or ameloblastoma'. Shear adds that it might be an odontogenic keratocyst. Harvey and Noble[5] report a similar lesion found in an East Indian skull.

A photograph of a skull housed in the Abelholt monastery museum in Denmark of a subject buried in the Middle Ages, shows a cystic cavity involving the apices of the left maxillary central and lateral incisors. The incisal edge of the central has been notched, possibly for ritual purposes.

There is an extensive discussion of the surgical treatment of dental problems in the work of Johannes Scultetus of Ulm, Germany, whose book Armamentarium chirurgicum first appeared in 1655 and was later reprinted in several languages, including English. Scultetus, an ardent follower of Galen, relied on the Roman doctor's methods to prepare his patients for operation. Thus, in the case of a woman who had a cyst of the maxilla, he initiated treatment with bleedings, purgings, sweatings, and the application of various drawing ointments to remove the excess 'moist humors'. This done, he placed the lady in her bed, tying her hands to her side, and incised the cyst. There 'flowed out a thick yellow matter like honey, and the tumor subsided'. Scultetus followed the operation with vigorous treatment of the cystic cavity for a period of two months and apparently achieved healing.

Pierre Fauchard in 1746 published his second edition of his epic work Le chirurgien dentiste consisting of two small volumes, this was the most important book on dentistry to appear and it was to remain the authoritative work in the field during the next century. Fauchard's "Sixth Observation" in Chapter 35 of this book appears to be a case report of a radicular cyst, although he does not give any specific name to the condition he describes.

> "On the effect of caries of two roots of a tooth which gave rise to a tumour and abscess on the left side of the lower jaw. I was called to examine this tumour and to extirpate the two roots; the gap which was left enabled me to insert my stiletto into the tumour. By this means I ascertained the depth which extended to the base of the maxillary bone. I knew then that the bone was exposed. I

made a sufficient incision in the upper part of the gum to give vent to the matter, and, to prevent the opening of the wound being closed too soon, I dressed this lady with a tent of lint covered over with a little white wax. I renewed this tent night and morning and syringed out the wound every time that I dressed it with a lotion made of two ounces of water of ound wort, barley water with cinnamon, balsam of Fioravanti and honey of roses of each one ounce, the whole mixed together. The fourth day I ceased to use the tents and continued to syringe the wound as formerly until the twenty-fifth day when the patient was perfectly cured".

John Hunter, writing in about 1780 of diseases of the jaw bones, described a type of lesion which appears to be a cyst.

"The second of these diseases in the bone....is an accumulation of curdly substance; probably it is coagulable lymph, and may be reckoned among the encysted tumours. The ossific inflammation often goes on here, till the bone acquires great size, but in these the outer ossific accumulation is not in proportion to the absorption, and therefore, being only a thin shell, it gives way".

Heath[6], in his lecture notes to the College of Surgeons, wrote about some interesting cases he and his colleague had operated on.

"Mr. S. Cartwright was inclined to think that cystic tumours more often had their origin in the teeth than was generally supposed,

> the peculiar connection of the teeth with the jaw favouring the hypothesis. In many cases the cysts were probably congenital, and formed in connection with the primitive sac of the tooth".

Mr. Hamilton Cartwright said that the character of the tumour Mr. Heath had just described was evidently not of the odontomatous or dentigerous kind. He believed that such growths were of dental origin- subacute, not acute- inflammation of the root being the first origin of the evil.

Heath wrote in his notes describing one such condition:

> "The swelling began 9 years ago and was the size of an ordinary orange - round, very hard and fixed to the angle of the lower jaw on the right side. It's edges were well-defined, there was no fluctuation nor pulsation, except that of the facial artery, which was stretched over the tumour. On puncturing from the mouth through the bony wall, I entered a large empty cavity lined with soft tissue, which on microscopical examination showed portions of hyaline cartilage and cartilage with a faintly fibrous material, surrounded by and gradually passing into oval and spindle cells".

Other early work on the nature and treatment of jaw cysts appears in the English literature in papers by Spence[3], Harvey[8], Moon[9], Baker[10] and Turner[11].

Chapter 2

Classification

CLASSIFICATION

A cyst is a pathological cavity having fluid, semifluid or gaseous contents and which is not created by the accumulation of pus (Kramer[12]). It is frequently, but not always, lined by epithelium.

Cysts of the jaws comprise a group of lesions which are relatively common within the mandible and maxilla, making these bones the most commonly affected by cystic lesions in the entire skeleton. A cyst may form either as a primary disease process or secondarily as a change in some other condition, for instance, a neoplasm. Such a change is quite common in some forms of neoplasms affecting the jaws, for example, the ameloblastoma. Although the cystic change may become the outstanding clinical feature in such neoplasms, it is the neoplastic character of the lesion which determines its clinical behaviour and prognosis and sets it apart from other forms of cysts. Cysts arising in this way are not part of the subject matter of this dissertation.

There have been many different classifications of cysts of the jaws over the years and most of them have formed a practical basis for the understanding and treatment of these lesions, based upon the knowledge existing at the time. The earliest classifications were based primarily upon the varied clinical and radiological presentations of the different forms of cyst, and relatively little note was paid to their histological features. This was hardly

surprising, since such classifications were promoted mostly by clinicians and the dicipline of oral pathology was only in its infancy.

The emergence of oral-pathology as a properly recognized specialty in dentistry has led to a rationalization of these differences and the presentation of more generally acceptable classifications. It is now widely recognized that some different types of cysts have histologically distinguishable cyst walls, but by no means all of them; that cysts with a particular histological type of wall behave differently clinically from other cysts; and that the histological features are at least as important as the clinical and radiological parameters in the classification of cysts of the jaws. This change is exemplified by the recognition in 1956 by Philipsen[13] of a group of cysts which showed a characteristic histological recognition of a hitherto unidentified form of cyst, the odontogenic keratocyst.

Attempts to classify cysts of the jaws have also been plagued by the use of a variety of different terms by different authors to describe the same pathological entity, particularly where classifications have been proposed by authors from different countries.

There has been a multiplicity of suggested classifications for benign cystic lesions of the jaws. One of the first academic surveys on this subject was conducted by the British Dental Association Committee on Odontomes which published its report in 1914.

Most classifications of epithelial cysts of the jaws have been based on the suspected origin of the lining epithelium. The first modern and precise

system was devised by Robinson[14] with the co-operation of other authorities in the field of medicine and dentistry. For classification the cysts were subdivided into two specific groups based on the primal source of the epithelial tissue; that is odontogenic and non-odontogenic cysts.

ROBINSON'S CLASSIFICATION (1945)

DEVELOPMENTAL CYSTS

(A) From Odontogenic Tissue

- (1) Periodontal Cyst.
  - (a) Radicular or dental root apex type.
  - (b) Lateral type.
  - (c) Residual type.
- (2) Dentigerous cyst.
- (3) Primordial cyst.

(B) From Non-dental Tissues

- (1) Median cyst (median palatine cyst).
- (2) Incisive canal cyst.
- (3) Globulo-maxillary cyst.

Robinson's classification was adopted by Thoma and Goldman[15] (1960) with minor modifications.

THOMA-ROBINSON-BERNIER CLASSIFICATION (1960)

ODONTOGENIC ECTODERMAL EPITHELIAL CYSTS

(A) Follicular Cysts

- (1) Primordial cysts.
- (2) Dentigerous cysts.
  - (i) Lateral
  - (ii) Central.

(B) Periodontal Cysts (radicular)

- (1) Apical.
- (2) Lateral.

(C) Residual Cysts

- (1) Follicular.
- (2) Periodontal.

(D) Multiple Cysts

(E) Multilocular Cysts

(F) Polycystoma Cysts

(G) Cholesteatoma

NON-ODONTOGENIC ECTODERMAL EPITHELIAL CYSTS

(A) Interosseous Cysts

(1) Median.

(2) Intermaxillary.

(3) Naso-alveolar.

(B) Nasopalatine Cysts

(1) Incisive canal cysts.

(2) Cyst of papilla palatina.

In 1961, Robinson himself expanded his original classification to include cysts of the soft tissues.

In recent years, many authors have endeavoured to subdivide cysts of the jaws as developmental or inflammatory on the basis of their likely pathogenesis. It is well documented that the process of odontogenesis involves a series of complicated and extensive epithelial proliferations and that once each stage of tooth formation is complete, the epithelium undergoes involution, but only partially, and always leaves behind residues either within the oral mucosa, the periodontal ligament, or the adjacent bone. Many cysts arise without any obvious aetiological stimulus and there is much evidence, albeit circumstantial, that such residues may undergo proliferation and lead to cyst formation: such cysts are generally described as being developmental in origin. On the other hand, foci of inflammation are common in and around the teeth as a consequence of the two major dental diseases, dental caries and periodontal disease. Epithelial hyperplasia arises if residues are affected by such inflammation and as a consequence cyst

formation may occur. Such cysts are usually designated as being inflammatory in origin. However, many developmental cysts contain infiltrates of inflammatory cells within their walls to a greater or lesser degree, thus making the distinction between the two categories of cyst less definite. Nevertheless, it is widely believed that the stimulus to the initial epithelial hyperplasia is different in the two groups and that the distinction is therefore valid.

Kruger's classification[16] included a number of cysts of the soft tissues of the oral cavity and contiguous structures.

KRUGER'S CLASSIFICATION (1964)

(A) Congenital Cysts

(1) Thyroglossal .

(2) Branchiogenic.

(3) Dermoid.

(B) Developmental Cysts

(1) Non-dental origin.

(a) Fissural types.

(i) Naso-alveolar.

(ii) Median.

(iii) Incisive canal (nasopalatine).

(iv) Globulomaxillary.

(b) Retention types.

(i) Mucocele.

(ii) Ranula.

(2) Dental origin.

(a) Periodontal.

(i) Periapical.

(ii) Lateral.

(iii) Residual.

(b) Primordial.

(c) Dentigerous.

In Seward's classification the cyst groups are graded in a logical order and range widely in type from cystic neoplasms and bone cysts to the common dental and fissural groups.

SEWARD'S CLASSIFICATION (1964)

Cysts With An Epithelial Lining

(A) From Non-odontogenic Epithelium

(1) Maxillary.

(a) Nasopalatine.

(i) Incisive canal cyst.

(ii) Incisive papilla cyst.

(b) Globulomaxillary cyst.

(c) Median palatine cyst.

(d) Nasolabial cyst.

(2) Mandibular.

Median mandibular cyst.

(B) From Odontogenic Epithelium

(1) Associated with the crown of the tooth.

(a) Cyst of eruption.

(b) Dentigerous cyst.

(i) Pericoronal.

(ii) Lateral.

(iii) Residual.

(c) Extra-follicular dentigerous cyst.

(2) Associated with the root of the tooth.

(a) Inflammatory periodontal or radicular cyst.

(i) Apical.

(ii) Lateral.

(iii) Residual.

(b) Developmental periodontal cyst.

(3) Unassociated with a tooth.

(a) Primordial.

(b) Rare entities.

(i) Cyst of interdental papilla.

(ii) Some gingival cysts.

(4) Cystic neoplasms (may occur in both solid and cystic form).

(a) Ameloblastoma.

(b) Adeno-ameloblastoma.

(c) Ameloblastic odontome.

Cysts Without An Epithelial Lining

(A) Bone Cysts

(B) Stromal Cysts in Neoplasms

Lucas's classification (1964) included a group of cysts under the heading of "Fissural Cysts". These were alleged to arise from epithelial inclusions at the lines of closure of embryonic processes or from vestigial epithelial remains. Klestadt[17] (1921) postulated the origin of these cysts in epithelium remaining in the lines of closure of the processes and Scott[18] (1955) demonstrated the presence of microcysts in these areas in foetal material. However, Ferenczy[19] (1958) and others had pointed out that not all of these cysts were located in the lines of closure, and thus the term "fissural" cysts may be inaccurate. Nevertheless Lucas[20] argued that the lesions form a well defined group, and he thought it convenient to use this generic name.

LUCAS'S CLASSIFICATION (964)

Intraosseous Cysts

(A) Fissural Cysts

(1) Median mandibular.

(2) Median palatal.

(3) Nasopalatine.

(4) Globulomaxillary.

(5) Nasolabial.

(B) Odontogenic Cysts

(1) Developmental.

(a) Primordial.

(b) Dentigerous.

(2) Inflammatory.

(3) Radicular.

Non-epitheliated Bone Cysts

(1) Solitary bone cyst.

(2) Aneurysmal bone cyst.

Cysts Of The Soft Tissues

(1) Salivary.

(2) Gingival.

(3) Dermoid.

(4) Branchial.

(5) Thyroglossal.

(6) Nasolabial.

In 1970, Main[21] presented a clinico-pathological reappraisal of epithelial jaw cysts in which he recognized three basic categories: 1) primordial varieties, including the classic 'replacement' presentation, the 'envelopmental' enclosing a tooth, the 'extraneous', remote from teeth, and the 'collateral' alongside a vital tooth uninvolved by periodontal disease. 2), nonodontogenic, comprising only the 'interjacent', ' 'globulomaxillary' and 'nasopalatine' and 3), dental developing consequent on identifiable

tooth complications, this group consisting of the 'subfollicular coronal' (dentigerous) over the anatomical crown of an impacted unerupted tooth, the 'inflammatory coronal' around a partly-formed permanent crown involved by intrafollicular inflammation from a deciduous predecessor, the common 'radicular' and its (residual) counterpart, and the 'inflammatory collateral' alongside a vital tooth involved in pericoronitis.

The dental category included an entity not described in earlier classifications. This being the inflammatory collateral cyst which occurred alongside a partly-erupted tooth associated with pericoronitis. Although describing the histopathological features of these cysts as being similar to radicular cysts, no direct reference was made to the possible origin of their epithelial linings.

The most widely quoted classification of cysts of the jaws is that proposed in the WHO booklet, Histological Typing of Odontogenic Tumours, Jaw Cysts and Allied Lesions, published in 1971[22].

Over the intervening years since the World Health Organisation publication, the subject of jaw cystology continued to excite great interest as reflected in the wealth of published papers on this subject. Prominent among these was the monograph published by Shear[24] (1976) entitled 'Cysts of the oral regions'.

Other comprehensive reviews have been presented by Harris[25] (1975) Browne[26] (1976) and Gardner[27] (1978). More recent publications by Main[28] (1985) and Shear[29] (1985) have both proposed a revision of the WHO jaw cyst

classification to reflect current knowledge. This has culminated in the publication by the World Health Organisation, of a new booklet entitled 'Histological Typing of Odontogenic Tumours'[23]. The classification of the jaw cysts in this publication is shown below.

EPITHELIAL CYSTS

Developmental

(A) Odontogenic

(1)"Gingival Cysts" of infants (Epstein pearls)

(2) Odontogenic keratocyst (primordial cyst)

(3) Dentigerous (follicular) cyst

(4) Eruption cyst

(5) Lateral periodontal cyst

(6) Gingival cyst of adults

(7) Glandular odontogenic cyst: sialo-odontogenic cyst

(B) Non-odontogonic

(1) Nasopalatine duct (incisive canal) cyst

(2) Nasolabial (nasoalveolar) cyst

Inflammatory

(1) Radicular - apical and lateral

(2) Residual

(3) Paradental (inflammatory collateral, mandibular infected buccal) cyst.

Although several embryologists had previously questioned the embryonic premise on which the so-called globulomaxillary cyst was based, it was Christ[30] who gave convincing evidence against the fissural epithelial entrapment theory and support of an odontogenic derivation for the cystic lesions which arise between the maxillary lateral and canine teeth. The embryological fallacy has also been endorsed by Ten Cate[31]. In a recent study of 37 clinical globulomaxillary cysts by Wysocki[32] the revised diagnosis was 19 radicular, 6 periapical granuloma, 4 devolopmental lateral periodontal, 3 odontogenic keratocysts, 3 central giant cell granuloma, 1 calcifying odontogenic cyst and 1 odontogenic myxoma. Accordingly, the evidence against the esistence of this entity is overwhelming.

In these last years, several odontogenic cysts of presumably inflammatory origin have been described that seem to have been overlooked previously. In a study of epithelial jaw cysts, Main[33] briefly described an odontogenic inflammatory cyst termed the inflammatory collateral cyst. Seven of the eight cysts involved a mandibular third molar and one a maxillary canine. Chronic pericoronitis was associated with the partly erupted tooth in all eight cases. The histologic features of the collateral inflammatory cyst were described as being similar to those of the radicular cyst.

Craig[34] has given a detailed account of an inflammatory cyst that occurs on the buccal and distal aspects of the root of a partially erupted mandibular third molar in cases where there is a history of pericoronitis. The cysts were lined with a hyperplastic, nonkeratinized stratified squamous epithelium, and an intense inflammation was present in the connective tissue of the cyst wall. Craig[34] suggested the term 'paradental cyst' for this

clinicopathologic entity, which he considered the same as the inflammatory collateral cyst described by Main[33].

The clinical and radiologic features of an odontogenic cyst located buccally or distally to the root of an erupted or partially erupted permanent mandibular molar have been described by Stoneman and Worth[35] as the mandibular infected buccal cyct. Most cysts occurred on mandibular first molars in children of four to eight years of age. The radiologic appearance of the cysts involving mandibular third molars was identical to the appearance of Craig's paradental cyst.

The clinical diagnosis from referring clinicians indicate that some of the cases created diagnostic and therapeutic problems. These problems are particularly evident for cysts involving a mandibular first or second molar; a diagnosis of marginal periodontitis being suggested in several cases. The paucity of reports in the literature describing this cyst and the previous lack of recognition of this type of cyst as an entity probably account for misdiagnosis; herein lies the importance of an updated classification of cysts.

Chapter 3

Radiology

RADIOLOGY

The classic radiological appearance of a cyst is that of a well-defined round or oval area of radiolucency, circumscribed by a sharp radiopaque margin. The role of radiography in the diagnosis and treatment of bone lesions is very important; a minimum of two films should be taken at right angles to each other or as close to this as is practical. Usually with large cysts in either jaw extra-oral radiography is an essential supplement to the conventional intra-oral view.

Intra-oral Radiography

In general, the images seen on intra-oral radiographs are sharper than those seen in extra-oral views. The necessary intra-oral projections are periapical films and occlusal views.

Periapical Films

These provide a detailed evaluation of the pathological lesion. Valuable information such as: the periapical condition of the roots and their apical relationship to the lesion; a clear demonstration of the extremities of the lesion and the condition of the lamina dura. If the lesion is small, it can be

demonstrated in its own entirety on a periapical film. In the case of larger lesions occlusal and extra-oral radiographs are usually necessary.

Two intra-oral projection techniques may be employed in periapical radiography: the paralleling technique and the bisecting angle technique. Although each has evolved as the result of efforts to minimize image distortion, the paralleling technique is generally preferred because, with it, a less distorted view of the dentition is obtained. However, morphological variation from mouth to mouth and, even with the same oral cavity, poses a variety of geometrical problems that repeatedly emphasise the fact that each technique has advantages and disadvantages, and must be modified to accommodate the immediate circumstances.

Occlusal Views

This provides a more extensive view of the maxilla and mandible than does the periapical film. Since it provides views that are at approximately right angles to those obtained by the standard intraoral dental and the extraoral lateral jaw films. These views are used for the examination of expansile lesions of the alveolus in order to determine the medial and lateral extent of such pathoses as cysts, as well as to detect their presence in the palate.

There are two separate classes of occlusal projections; the true occlusal, and the oblique occlusal.

Maxillary Occlusal Radiography

Standard Maxillary Occlusal

This is an oblique occlusal of the maxilla with the central ray in the sagittal plane. (Fig 3.1)

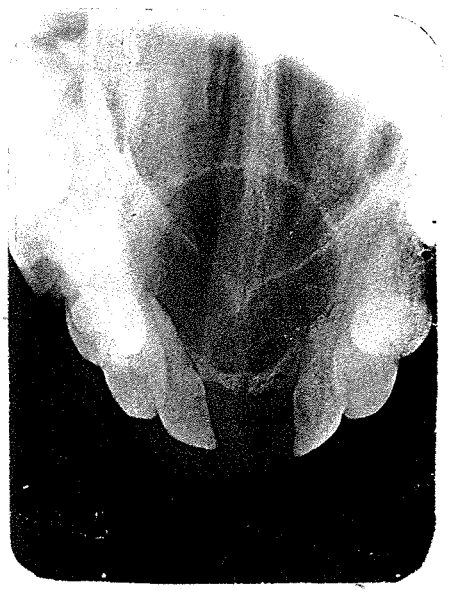

Figure 3.1 Maxillary standard occlusal radiograph, showing a large, clearly defined, radiolucent lesion bounded by a radiopaque lamina in the midline of the maxilla in which both central incisor teeth are absent.

This projection is used to give a general view of the upper incisor and canine regions and the anterior part of the hard palate. In the adult it is usually used to delineate the extent of the gross pathology of the upper

anterior region, such as the outline of a cyst, the full extent of which cannot be visualized on a periapical radiograph.

Oblique Posterior Maxillary Occlusal

This is a projection which shows bony changes in the region of the apices of the cheek teeth better than the standard occlusal (Fig 3.2). It shows the extent of a pathological lesion and may help to differentiate the outline of a cyst from that of the maxillary sinus.

Figure 3.2 The oblique posterior maxillary occlusal radiograph

Mandibular Occlusal Radiography

Lower Anterior Occlusal Projection

This projection shows the anterior parts of the mandible in the incisor and canine region and these teeth will appear foreshortened (Fig 3.3). It is a useful view for showing the extent of any lesion too large to be shown adequately on a periapical film.

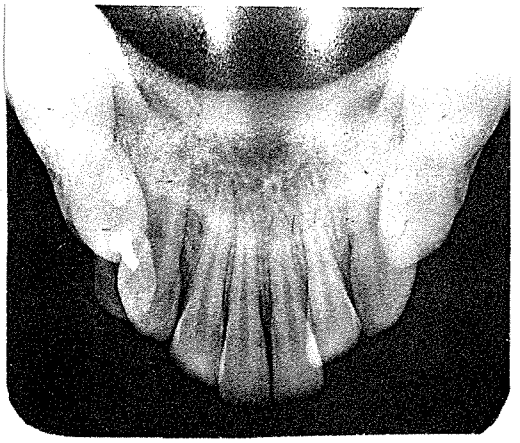

Figure 3.3 The lower anterior occlusal radiograph

Lower True Occlusal

This view gives a plan of the mandible from below, and shows the soft tissue of the floor of the mouth (Fig 3.4). It is useful to show expansion of the buccal or lingual plates of the mandible.

Figure 3.4 The mandibular true occlusal radiograph

Extra-Oral Radiography

Extra-oral radiography should demonstrate the full extent of the abnormality and provide an accurate reproduction of the normal marginal bone encompassing the lesion.

Oblique lateral radiograph

This is an extra-oral view of the jaws that can be taken using a dental X-ray set. Before the development of dental panoramic equipment they were the routine extra-oral radiographs used both in hospitals and in general practice. In recent years their popularity has waned, but the limitations of dental panoramic tomographs have ensured that oblique lateral radiographs still have an important role. They are useful to show the extension of a pathological lesion -such as a cyst- into the ramus and whether it is

encroaching upon or perforating the lower border of the mandible. It is also useful for assessing cystic involvement of the ramus and demonstrating displacement of the inferior dental canal and migration of teeth (Fig 3.5).

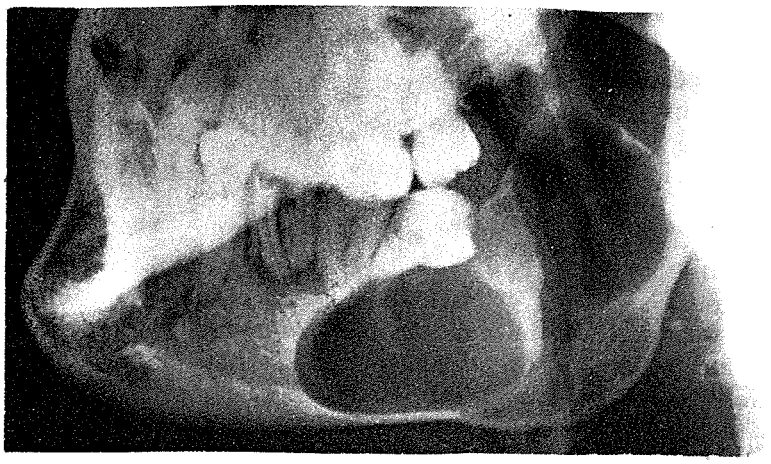

Figure 3.5 Lateral oblique jaw

Postero-anterior projection of the mandible

This view shows the posterior parts of the mandible. It is not useful for showing the facial skeleton because of superimposition of the base of the skull and the nasal bones. It is a useful view for lesions such as cysts in the posterior third of the body or rami to detect any medio-lateral expansion (Fig 3.6).

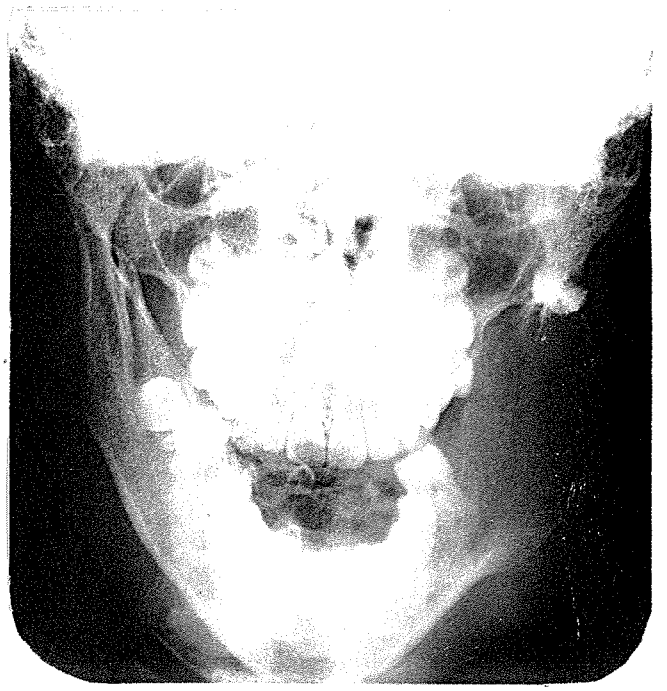

Figure 3.6 Postero-anterior projection of the mandible showing a large, radiolucent lesion of the left ramus associated with an unerupted mandibular third molar tooth, which has been displaced into the neck of the condyle.

Lateral Skull View

This projection shows the skull vault and facial skeleton from the lateral aspect (Fig 3.7). It is an excellent projection for:

(1) localising a high, unerupted tooth associated with a large maxillary dentigerous cyst,

(2) determining the upper margin of a large odontogenic cyst invading the antrum, and

(3) delineating the limits of a mucous cyst of the maxillary sinus.

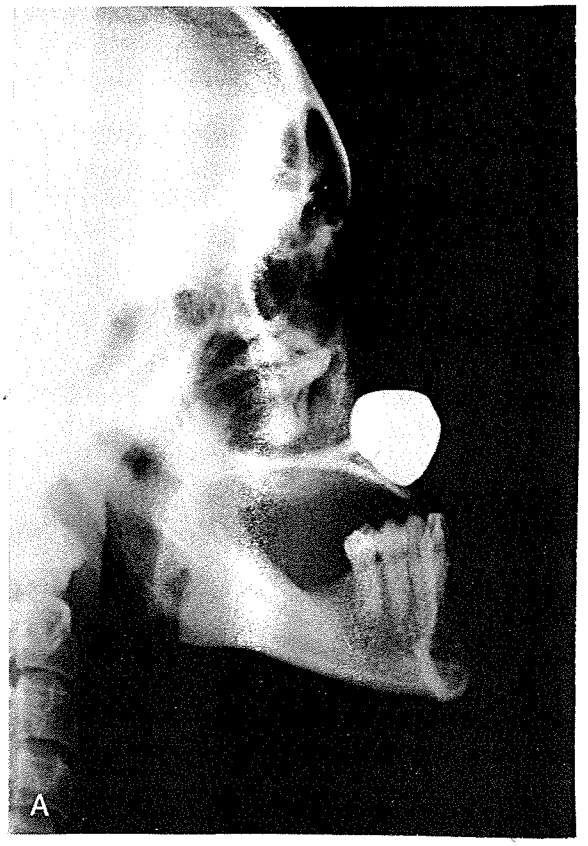

Figure 3.7 Lateral skull radiograph of nasolabial cyst with contrast medium injected into the area to delineate the lesion.

Occipitomental Projection

This projection shows the facial skeleton and maxillary antra, and avoids superimposition of the dense bones of the base of the skull. It is a good projection to show a cyst in relation to the antrum (Fig 3.8).

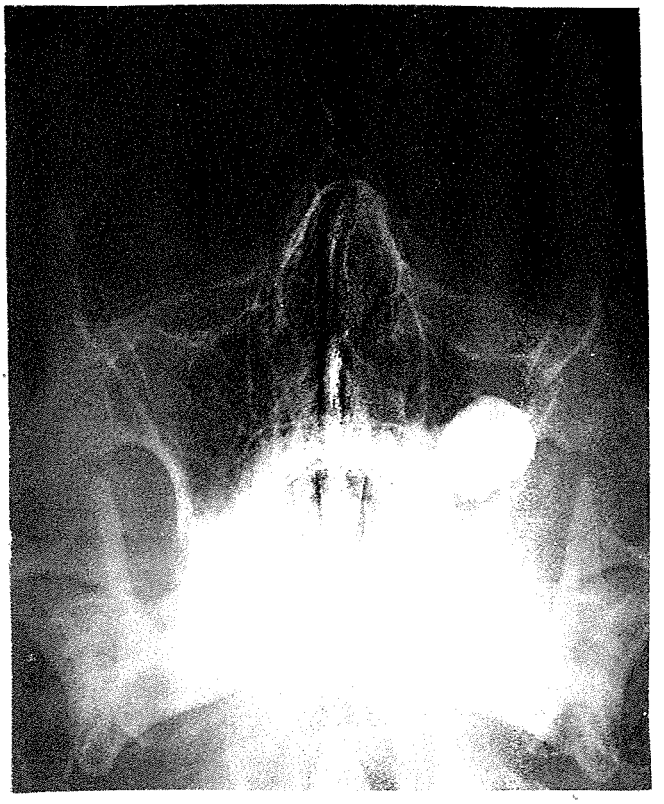

Figure 3.8 A useful adjunct in determining the extent of cystic lesions in the maxilla, or when there is difficulty in deciding whether a radiolucent area is cystic or merely part of the antrum, is to inject radiopaque contrast medium into the area. If it is cystic, the cavity of the lesion becomes filled with radiopaque medium forming a circular mass of smooth outline typical of an expansile cyst.

Dental Panoramic Radiography

This is a radiographic procedure that produces a single image of the facial structures, including both maxillary and mandibular arches and their supporting structures (Fig 3.9). A major drawback to the technique is that it produces a sectional radiograph, only structures within the section or focal trough will be in focus on the film. It provides an excellent screening film due to its ability to demonstrate radiographic changes throughout the maxillae and mandible.

It is ideal for revealing lesions such as cysts and is especially useful where lesions are multiple in different sites of the jaws, and also when the lesions are extensive and cross the mid-line.

Panoramic radiography has replaced,to a considerable degree, oblique lateral radiography. It is important to note that the dental pantomograph is not a substitute for intra-oral films where a high degree of resolution is required because there is a loss of definition associated with both the tomographic process and the use of intensifying screens.

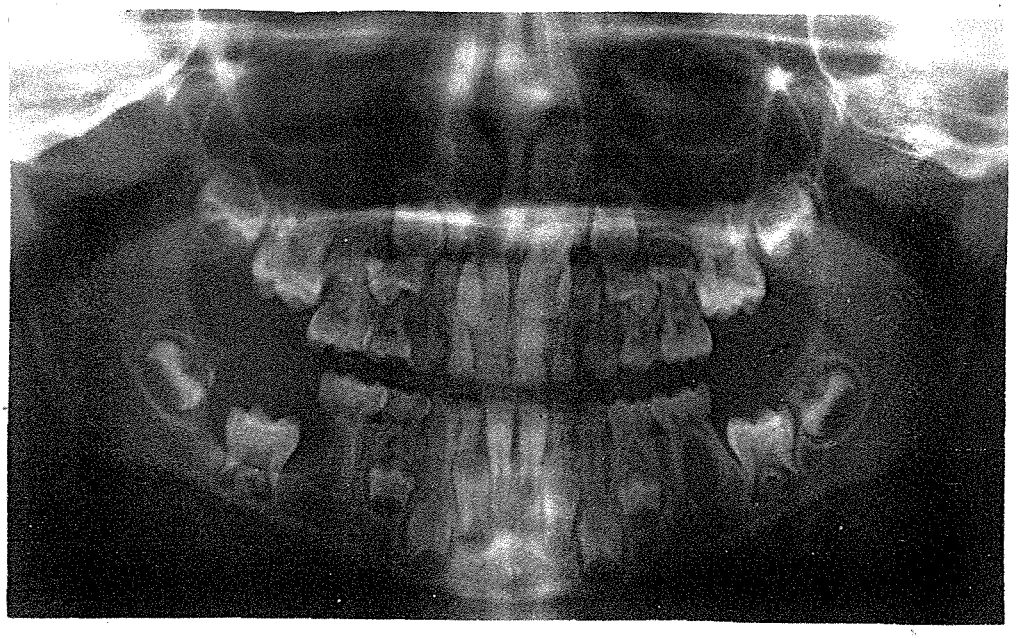

Figure 3.9 Dental panoramic tomograph showing a small circular, radiolucent cyst encompassing the crown of the left mandibular first molar tooth.

Chapter 4

Radiological Features of Cysts

RADIOLOGICAL FEATURES OF CYSTS

Even though epithelium-lined cysts of the jaws have a varied origin, all have a similar morbid anatomy and mode of growth. It is to be expected therefore that they will have a number of radiographical features in common. Classically, cysts appear as a well defined round or oval area of radiolucency, circumscribed by a sharp radiopaque margin.

Margins

Superimposed infection may result in modification of the cortical margin of a cyst, so that the peripheral white line becomes ill-defined, discontinous or absent. "Scalloped" well-corticated margins are a feature of larger keratocysts. The margins of simple (solitary) bone cysts are usually not corticated.

Shapes

Small cysts in cancellous bone are round, but as they become larger their circular shape tends to be lost due to the differing degrees of peripheral resistance offered to their expansion. Contact with mandibular cortical plates retards the rate of growth laterally and medially, thus increase in size tends to take place along the longitudinal axis at the expense of the less solid

cancellous tissue which provides a path of reduced resistance. In the mandible, a cyst may extend along the whole length of the jaw and assume an elongated sausage shape with minimal discernable external deformity.

When expansion of the cortex does occur in the mandible, there is a tendency for it to be more pronounced on the labial or buccal aspects. The exception to this trend is encountered in the third molar region due to the relative thiness of the lingual plate.

Locularity

Locularity is supposedly a feature of keratocysts and some other very large cysts. However, true multilocularity is not common. It is often a projection effect of the elevations or ridges in the cyst walls which are consequent upon differential bone resorption.

Displacement of normal anatomy

This is a feature of cysts and benign tumours. The presence of a large cyst in the mandible may cause downward displacement of the dark band of the inferior dental canal and a discontinuity in one or both cortical lines which outline this canal.

Expanding cysts impinge upon either the roots of erupted teeth or the crowns of unerupted teeth. Displacement of the teeth to the periphery of the

lesion is the usual response, a slight indentation forming in the outline of the cyst. As the roots of erupted teeth are deflected in one direction the crowns are inclined in the opposite direction.

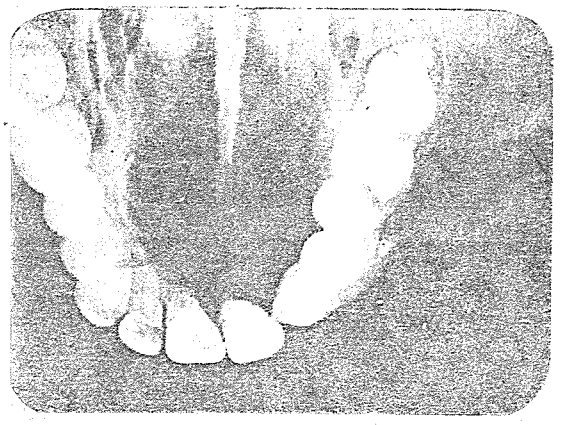

Figure 4.1

Thus a maxillary cyst may cause the related teeth to tilt with their crowns towards the palate so that they appear foreshortened in periapical films taken with conventional angles. The roots of teeth may resorb with a clean-cut margin, with the edge in line with that of the lesion itself. Antral and nasal floors may also be displaced from their normal position.

Perforation of cortical plates

An expanding lesion may eventually perforate one or more related cortical plates, more commonly in faster growing lesions. The hole through the bone is evidenced by an area of increased radiolucency within the cyst shadow.

Inclusion of unerupted teeth

Although the inclusion in a cyst of the crown of an unerupted tooth is suggestive of a dentigerous cyst, it is not diagnostic. The tooth may have been intimately associated with a neoplasm or another type of cyst, the enlargement of which has enclosed the tooth at an early stage or moved it so that it lies somewhere along the periphery of the lesion and becomes partially enveloped (Fig 4.2).

Figure 4.2 Radiograph of a keratocyst which has enveloped an unerupted tooth to produce a 'dentigerous' appearance.

Chapter 5

Odontogenic keratocyst (primordial cyst)

ODONTOGENIC KERATOCYST (PRIMORDIAL CYST)

The odontogenic keratocyst is a distinct entity of developmental origin which arises from odontogenic epithelium[36,37]. Most of the available evidence points to two main sources of epithelium from which the cyst is derived, namely the dental lamina or its remnants[36-41], and extensions of basal cells from the overlying oral epithelium[42-45].

It has been defined as "a cyst arising in the tooth-bearing areas of the jaws or posterior to the mandibular third molar and characterised by a thin fibrous capsule and a lining of keratinised stratified squamous epithelium, rarely exceeding about five cells in thickness and having no rete processes"[23].

There is a great deal of controversy regarding the correct usage of the terms primordial cyst and odontogenic keratocyst. In its original usage, the term primordial cyst was reserved for cysts which arose from odontogenic epithelial primordia in place of a tooth of the normal dentition. Thus they had a characteristic radiological presentation; where a cyst-like radiolucency was present in the bone at a site where no tooth had developed (Fig 5.1).

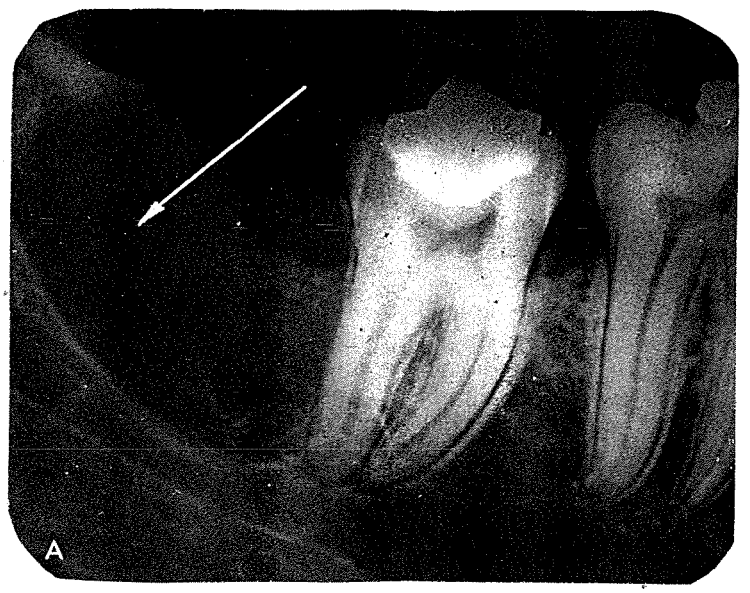

Figure 5.1 Primordial cyst developing in the region of a mandibular third molar tooth.

The term "odontogenic keratocyst" is much more recent and was first introduced by Philipsen in 1956[46]. This term was based upon the characteristic histological appearance of a group of odontogenic cysts which clearly distinguished them from others[47,48]. Such cysts have, however, a wide variety of radiological appearances such that they simulate most other types of odontogenic cyst[49-52]. Indeed, the presentation of a primordial cyst as originally described is one of the least common radiological appearances. This variety of presentations has led to confusion in their classification in

the past. However, careful analysis has indicated that odontogenic keratocysts have a statistically significant different age and site distribution from other forms of odontogenic cyst[53,54], and should therefore be classified separately. The confusion has been added to as it is now recognized that keratin metaplasia can occur in other types of odontogenic cyst[54,55]. However, when such metaplasia occurs, its histological appearance is quite different from that of an odontogenic keratocyst.

Incidence

The reported frequency of odontogenic keratocysts varies from 3.2per cent[57] to 21.8 per cent[58] of all odontogenic cysts. The varying frequencies in the different reported series (Table 5.1) is probably due in part to the differing range of material seen by the departments from which the reports have emanated.

Table 5.1 Frequency of keratocysts in different series

Author(s)	Material	%
Pindborg et al., 1962	26 of 791 odontogenic	3.3
Toller, 1967	33 of 300 cysts, all types	11.0
Hjorting-Hansen et al., 1969	56 of 502 odontogenic	11.2
Browne, 1970	41 of 537 odontogenic	7.6
Main, 1970a	12 of 289 epithelial cysts	4.2
Stoelinga, 1971	54 of 486 jaw cysts	11.1
Killey et al., 1977	25 of 746 jaw cysts	3.3
Payne, 1972	103 of 1313 odontogenic	7.8
Radden and Reade, 1973	64 of 368 odontogenic	17.4
Brannon, 1976	312 of 2972 oral cysts	10.5
Craig, 1976	85 of 1051 odontogenic	8.1
Djamshidi, 1976	91 of 417odontogenic	21.8
Hodgkinson et al., 1978	78 of 1100 jaw cysts	7.2
Magnusson, 1978	52 of 1420 odontogenic	3.2
Ahlfors et al., 1984	319 of 5914 jaw cysts	5.4
Reff-eberwein et al., 1985	82 of 3328 odontogenic	2.5
Hoffmeister and Harle, 1985	51 of 3353 jaw cysts	1.5
Hondell and Wiberg, 1988	29 of 531 jaw cysts	5.4
Shear	292 of 2616 jaw cysts	11.2
Camilleri, 1993 (present study)	9 of 107 jaw cysts	8.4

Age and Sex

There is a wide age range within which the odontogenic keratocyst occurs, the lowest reported age at diagnosis is seven years[59], and the highest eighty three years[60]. In most series there has been a pronounced peak frequency in the second and third decades, with figures ranging from fourty per cent to sixty per cent of patients being in this age group.

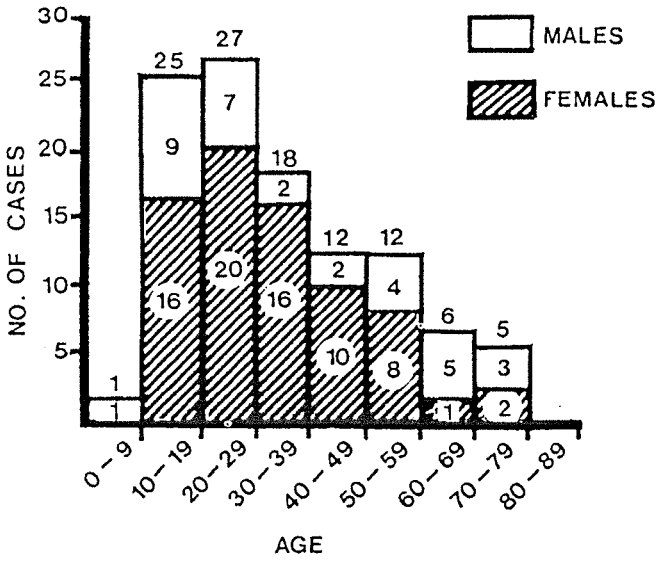

Figure 5.2 Ages of patients at diagnosis of 106 keratocysts.

It is generally agreed that the distribution of age at diagnosis of odontogenic keratocysts is bimodal with a second peak in the fifth decade or later[52,57,61-65].

Woolgar, Rippen and Browne[66] have pointed out that the mean age of patients with multiple keratocysts, with or without the naevoid basal cell carcinoma syndrome, is considerably lower than the mean age of patients with single non recurrent keratocysts and that pooling patients from the

three groups will account for differences in age distribution reported in different studies.

Most studies show the incidence of odontogenic keratocysts in males to be higher than that in females, the majority of the figures being of the order of 1.6:1 to 1.9:1[60,63,66,67]. In some studies, however, an equal sex distribution has been observed[61]. In a sample of twenty patients with multiple keratocysts of whom ten had the naevoid basal cell carcinoma syndrome, Brannon[51] observed a female preponderance of 17:1

Site Distribution

It is generally agreed that most odontogenic keratocysts occur in the mandible, and most of these in the molar/ramus region. The frequency of mandibular involvement in a series of reported cases is 77 per cent (Hansen)[68]; 65 per cent (Brannon)[51]; 75 per cent (Ahlfors, Larsson and Sjogren)[60] and 69 per cent (Voorsmit)[64]. About one-half of all keratocysts occur at the angle of the mandible extending for varying distances into the ascending ramus and forward into the body. Maxillary keratocysts are noted chiefly in the third molar area, the canine region being the next most frequent site[52,66].

The Naevoid Basal Cell Carcinoma Syndrome

Binkley and Johnson[69] in 1951 reported the case of a 30 year old woman with multiple 'dental follicular cysts' involving both sides of the mandible. She

also had numerous hard papules situated over various parts of the body which histological examination showed were 'basal cell naevi'. A radiograph of the chest revealed an anteriorly bifid sixth rib. In 1960 Gorlin and Goltz[70] produced the first systematic account of a syndrome consisting essentially of multiple basal cell carcinomas of the skin, multiple odontogenic keratocysts of the jaws and bifid ribs. For a number of years the syndrome bore the name of these two authors, but later it became known as the basal cell naevus syndrome or the naevoid basal cell carcinoma syndrome. Since 1960 many other features of the syndrome have been described in numerous papers, most of these have been case reports or small series, though Gorlin himself published extensive up-dating reviews in 1971[71] and 1987[72]. The syndrome is inherited as a set of autosomal dominant characteristics with strong penetrance. It has variable expressivity, producing skin, jaw, other skeletal, central nervous system and eye lesions, as well as fairly typical facial features with frontal bossing and ocular hypertelorism. Keratocysts are one of the most consistent features of the syndrome, occurring in 65 to 75 per cent of cases and skeletal anomalies are also common.

Recurrences

One of the reasons for the special interest shown in keratocysts is their tendency to recur, especially after conservative surgical treatment but also even after radical operations. Pindborg and Hansen[73] were the first to point out this peculiarly aggressive behaviour. A recurrence rate of 62 per cent was found in this report but in an enlarged material, Hansen[68] found a recurrence rate of 52 per cent. Recurrence rates ranging from 14 to 62 per cent have been found by different authors, depending on the size of the material and the length of the postoperative follow-up period[52,61,74-76]. The variation in recurrence rate reported by different workers may be partly attributed to the variability in the follow-up period; in many reported series follow-up has been for as little as six months in some cases.

There are a number of possible reasons why keratocysts recur so frequently. The first of these is related to their tendency to multiplicity in some patients, including the occurrence of satellite cysts. Some instances of recurrence are likely to be new cysts rather than true recurrences. Secondly, keratocyst linings are very thin and fragile and are therefore more difficult to enucleate than cysts with thick walls. Portions of the lining may be left behind and constitute the origin of a recurrence. Forsell[52] in a follow-up study of 121 cases, showed that recurrences were extremely infrequent if the cyst was enucleated in one piece, but occurred in over one-half of cases when the cyst was removed in several pieces. He also found a higher recurrence rate when the cysts were located in the angle or ascending ramus of the mandible.

Another possible reason for the recurrences has been suggested by Stoelinga[77] and Stoelinga and Peters[78], who have proposed that the cysts may arise from proliferation of the basal cells of the oral mucosa, particularly in the third molar region and ascending ramus of the mandible. They referred to the fact that there is often firm adhesion of the cyst to the overlying mucosa and recommended that when they are surgically removed, the overlying mucosa should be excised with them in an attempt to prevent possible recurrence from residual basal cell proliferations.

As oral surgeons have become increasingly aware of the need to treat keratocysts more aggressively than other jaw cysts, it is likely that future studies will show a declining frequency of recurrences. It is difficult to ignore the possibility that the variability in reported recurrence rates may, at least partly, be attributable to differences in the surgical techniques used and in the experience of the surgeons. Forssell, Forssell and Kahnberg[76] have pointed out that in their series of keratocysts treated before 1975, the recurrence rate was 50 per cent, whereas in the group treated during the period 1975-80, the recurrence rate had dropped to 22 per cent.

Radiological Features

Keratocysts may appear radiologically as a well-circumscribed radiolucency with smooth margins and thin radiopaque borders. Multilocularity may be present and tends to be seen more frequently in larger lesions. Browne[50] found 19 of 83 cysts that is 23 per cent to be of this type, and Forssell[52]

observed a frequency of 25 per cent in a series of 135 cases, all in the mandible.

Keratocysts may occur in the periapical region of vital standing teeth, giving the appearance of a radicular cyst (Wright Wysocki and Larder[81]).

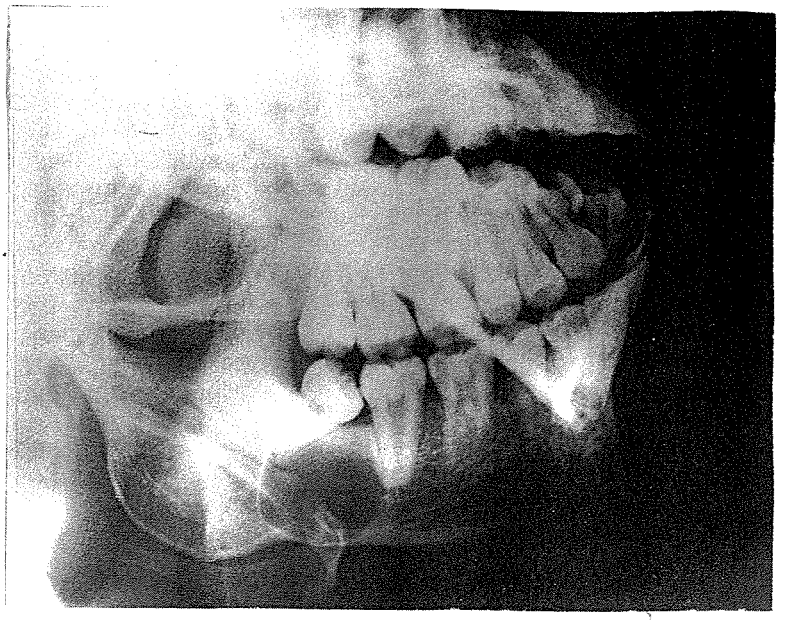

Figure 5.3 Radiograph of a unilocular keratocyst, having a smooth periphery.

They may impede the eruption of related teeth and this results in a 'dentigerous' appearance, however, careful examination of the radiographs suggests that the crown of the associated unerupted tooth does not project into the cyst cavity, but rather has been displaced by it.

Figure 5.4 In this 17-year-old, there is a large, radiolucent lesion of the left ramus associated with an unerupted mandibular third molar tooth which has been displaced to the lower border of the mandible.

This relationship is confirmed when the appropriate histological material can be examined[48]. However, in a small proportion of cysts, the odontogenic keratocyst is in true dentigerous relationship to the associated unerupted tooth[38,48]. This has given rise to the term follicular primordial cyst[79]. There is evidence that such lesions arise originally in an extrafollicular position,

discrete from the associated tooth, and subsequently either their epithelial linings fuse with the reduced enamel epithelium, so enclosing the entire anatomical crown of the tooth[38], or the tooth actually erupts into the cyst lumen[79,80] (Fig 5.5).

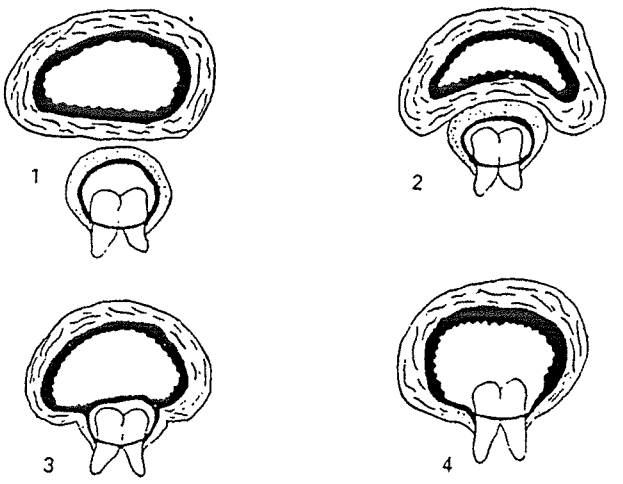

Figure 5.5 Histogenesis of the follicular keratocyst according to Altini and Cohen (1982). A tooth surrounded by its follicle erupts into a keratocyst cavity in the same way as it would erupt into the mouth.

In whatever way the relationship arises, such cysts should be regarded as a variant of the odontogenic keratocyst.

In addition to its radiological appearance as a dentigerous cyst, the odontogenic keratocyst can assume a variety of other presentations, including that of a lateral periodontal cyst, radicular cyst[81] and a residual cyst. It is this variety of clinical and radiological appearances that has contributed to the delay in the recognition of the odontogenic keratocyst as a distinct entity.

Postoperative radiological examination is important in the diagnosis of recurrences which depends on the presence of a corticated radiolucency which increases in size on a series of radiographs taken over a period of time. McIvor[82] pointed out that a diagnosis cannot be made with confidence on a single film as the bony defect following surgical removal of the cyst may be indistinguishable from a recurrence.

Chapter 6

Gingival Cysts of Adults, lateral periodontal cyst and glandular (sialo-) odontogenic cyst

GINGIVAL CYST OF ADULTS, LATERAL PERIODONTAL CYST AND GLANDULAR (SIALO-) ODONTOGENIC CYST

There is a great deal of confusion about the relationship between the gingival cyst of adults and the lateral periodontal cyst, much of which appears to have arisen because both types of cyst have a predilection for occurrence in the canine and premolar region of the mandible. Bhaskar[83] grouped the gingival and lateral periodontal cysts together as gingival cysts and considered that they both arise from extraosseous odontogenic epithelium. Wysocki et al[84] postulated, on the basis of the clinical and morphological similarities between the two cysts, that they have a common histogenesis and that they represent the intraosseous and extraosseous manifestations of the same lesion. Shear and Pindborg[85] regarded them as distinct lesions, as did Buchner and Hansen[86] who suggested, however, that they were probably of the same epithelial origin.

Gingival cyst of adults

The gingival cyst of adults is usually a painless, well circumscribed fluctuant soft tissue swelling seldom measuring over one cm in diameter, and may occur in the attached gingiva or the interdental papilla. It may be the colour of the adjacent normal gingiva or have a bluish tinge. The lesions are soft and fluctuant and the adjacent teeth are usually vital.

Incidence

Shear[89] reported only 14 cases out of a total of 2616 cysts of the jaws, that is only 0.5 per cent. The true frequency is probably higher. The study of Buchner and Hansen[86] shows that only 33 cases were retrieved from 21503 cysts over an 11-year period.

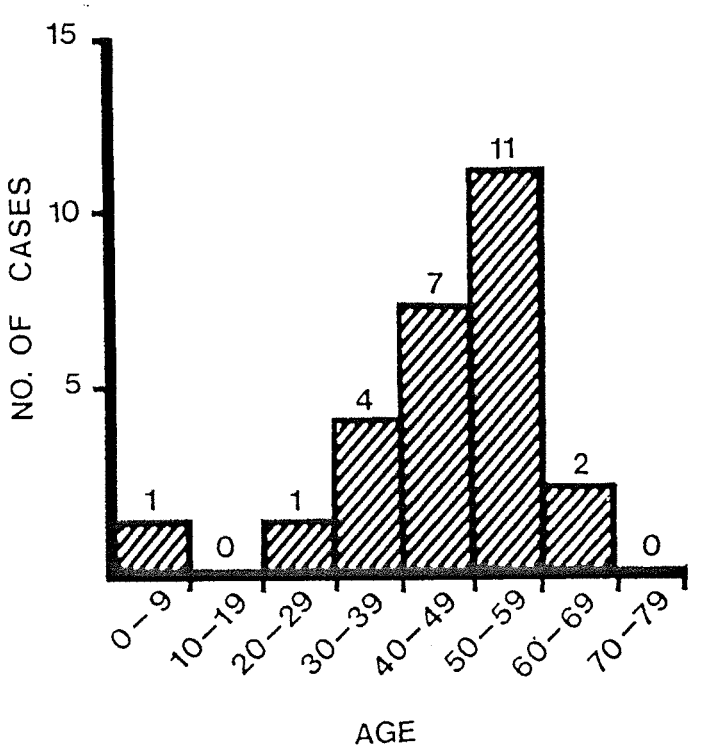

Figure 6.1 Age distribution of 26 patients with gingival cysts of the adult. (After Buchner & Hansen 1979)

Age and Sex

The gingival cyst may occur at any age but is most common in the fifth and sixth decades. In the review of the literature by Reeve and Levy[87], the majority of patients were over 40 years of age. The mean age in the 33 cases reported by Buchner and Hansen[86] was 48 years and that of the 10 cases reported by Wysocki and his associates[84] was 51 years.

Location

The location of the lesion closely follows that of the lateral periodontal cyst. All, except one cyst in the series of Wysocki and his coworkers were in the mandibular premolar canine-incisor region; the one exception being in the maxillary lateral incisor area. The locations in the series of Buchner and Hansen were virtually identical except that they had several cases in the maxillary arch, from canine to first molar.

Radiological Features

The gingival cyst is a soft tissue lesion and does not generally manifest itself on the dental roentgenograms. If it enlarges to sufficient size, it may cause superficial erosion of the cortical plate of bone, and thus may be visible only as a faint round shadow. Out of 46 cases diagnosed as gingival cysts in the

study of Moskow et al,[88] 19 showed radiolucencies, but only two of 33 cases showed this change in the report of Buchner and Hansen[86].

Because of an absence of other known aetiological factors, such as inflammatory stimuli, these cysts are regarded as being developmental in nature, despite the fact that they become increasingly common with age, up to the sixth decade[89]. However, a number of such cysts can be found as incidental findings in routine gingival biopsies in the absence of clinical signs[90] and so it is possible that they can be present for many years, even perhaps from infancy, before a swelling appears clinically. Occasionally, they are polycystitic[84].

Lateral Periodontal Cyst

In the past, the term lateral periodontal cyst has been used in a variety of ways and to include a number of cysts of clearly differing pathogenesis[91, 92]. Such lesions have included laterally placed cysts arising in an inflammatory focus of either pulpal (laterally placed radicular cyst) or periodontal (inflammatory collateral cyst, paradental cyst) origin, gingival cysts of adults and odontogenic keratocysts. If these other types of cysts are excluded, however, there remains a small group of cysts of presumed developmental origin which arise laterally to a tooth within the bone of the alveolus[85]; these are lateral periodontal cysts.

Incidence

The lateral periodontal cyst is a relatively uncommon but widely recognized odontogenic cyst. In Shear's series[89] only eighteen cases were registered between 1958 and 1989, representing 0.7 per cent of the 2616 cysts of the jaws seen during that period.

Age and Sex

The lateral periodontal cyst occurs chiefly in adults, according to the series of 39 cases reported by Wysocki and his associates[84] in which there was a mean age of 50 years and an age range of 22 to 85 years. In this series, there was a predilection for occurrence in males over females, 67:28 per cent with 5 per cent unknown. In the sample of 37 cases reported by Cohen et al[93], the ages of the patients ranged from 21 to 82 years with a mean of 54 years. There was a prominent peak distribution in the sixth decade as occurred also in the study of Rasmusson, Magnusson and Barrman[94].

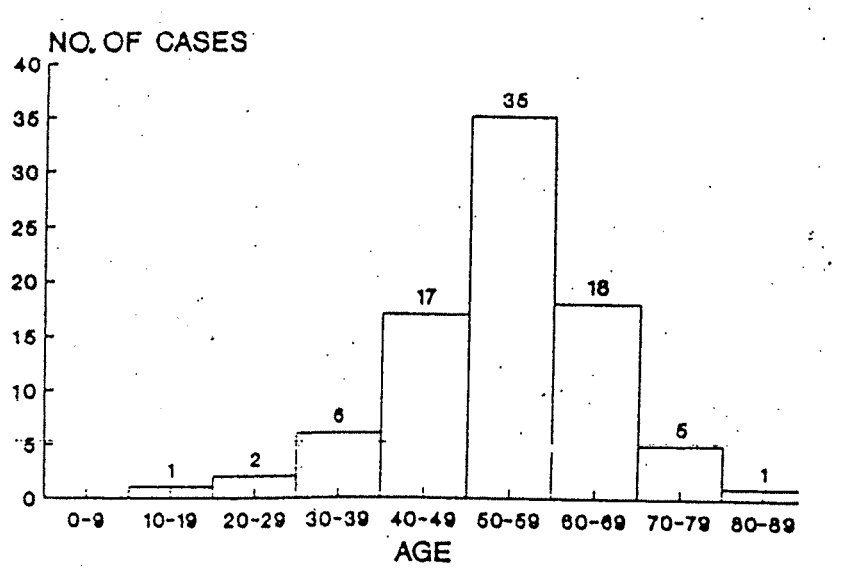

Figure 6.2 Age distribution of 84 patients with lateral periodontal cysts (Altini and Shear; Cohen et al and Rasmusson et al.)

Location

The most frequently reported location of the lateral periodontal cyst is the mandibular/premolar area followed by the anterior region of the maxilla. In one study (ref: 84), 26 of the 39 cases that is 67 per cent occurred in the premolar-canine-incisor region of the mandible and 7 of these were located between the first and second premolars.

In another series (ref: 92) all 12 cases which fulfilled the criteria for diagnosis as developmental lateral periodontal cysts occurred adjacent to the premolar or canine teeth of the mandible. In a third study (ref: 93) 78 per cent of cases occurred in the mandible, all of which were anterior to the first permanent

molar and most were between the premolars. In a recent investigation by Rasmusson et al[94], 28 of the cysts that is 88 per cent were found in the mandible and 4 in the maxilla. All were in the premolar-canine-incisor area. In the study of Altini and Shear[95], the distribution was somewhat different. Although all their cases occurred anterior to the first permanent molars, 10 of 19 cases were found in the maxilla, clustered anterior to the first premolar teeth.

Clinical Features

Often the lateral periodontal cyst does not present distinctive clinical symptoms and is discovered during routine radiographic examination. Occasionally, lateral periodontal cysts may be clinically observed if expanding near the buccal or lingual alveolar plates. In these cases, a dome-shaped, firm, immovable mass is present with the overlying mucosa usually appearing normal. However, some blanching may be noted from tissue distention or the cyst may have a bluish-grey tint. Pain has rarely been reported. Unless otherwise affected, the associated tooth is still vital. If the cyst becomes infected, it may resemble a lateral periodontal abscess and even seek to establish drainage.

Radiological Features

The periapical radiograph reveals the lateral periodontal cyst as a well-defined round or oval shaped radiolucent area, usually with a sclerotic margin. The cysts lie along the lateral surface of a tooth root between the alveolar crest and the root apex (Fig. 6.3).

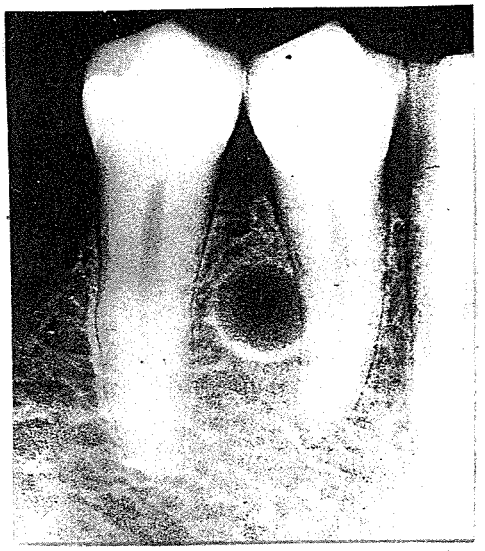

Figure 6.3 Radiograph of a lateral periodental cyst between the mandibular premolar teeth.

Resorption of the adjacent root has not been reported. The lesion is typically small, seldom over one centimeter except the botryoid variety, which may be larger and multi-locular (Kaugars[96] , Greer and Johnson[97]).

Botryoid Odontogenic Cyst

The botryoid odontogenic cyst first described by Weathers and Waldron[98] is accepted as a multilocular variant of the lateral periodontal cyst, originating from dental lamina rests. It has a predilection for the mandibular premolar - canine area in adults over the age of 50 years. Kaugars[96] reported three cases, one which occurred in the midline of the mandible, one between the mandibular premolars and one in an edentulous mandible; all three patients being in their fifties.

Greer and Johnson[97] reported 10 cases with a mean age of 46 years. Three of their cases represented recurrences 8, 10 and 10 years respectively, after previous surgery, and the authors supported Kaugar's concern that patients must be followed-up. Further documentation of the tendency for the botryoid odontogenic cyst to recur is provided in papers by Phelan et al[99], Heikinheimo et al[100] and Machado de Sousa et al[101].

Glandular Odontogenic Cyst (sialo-odontogenic cyst)

The glandular odontogenic cyst is an uncommon odontogenic cyst, originally described in 1988 by Gardner et al[102] as a distinct entity. In 1987 Padayachee and Van Wyk[103] reported two multilocular mandibular lesions with features of both botryoid odontogenic cyst and mucoepidermoid tumour, which they termed sialo-odontogenic cyst.

The name of the cyst is not yet established; the term most descriptive of the lesion is probably 'mucoepidermoid odontogenic cyst' because of the presence of both secretory elements and stratified squamous epithelium - Sadehhi et al[104], 1991.

Patron, Colmenero and Larrauri[105] reported three new cases and summarized the data from 13 cases (Table 6.1). The age range was 19-85 years, nine of the 13 cases were in men and 10 occurred in the mandible. Radiologically the lesions have been described to be well defined with a unilocular or multi-locular pattern, but without specific diagnostic features. Three of the ten cases that have been followed-up have recurred.

Table 6.1 Reports of 13 cases of Glandular odontogenic cyst

Age/Sex (yrs.)	Localization and X-ray findings	Treatment	Follow-up
69/M	Multilocular radiolucency of anterior mandible	Limited local excision	Recurrence of 3 yr; reexcision. No evidence of disease at 18 mo.
71/F	Multilocular radiolucency of anterior mandible	Limited local excision	NA
21/F	Maxilla, radiolucency	Enucleation & endodontic surgery	No recurrence after 3.5 years.
59/M	Anterior mandible, unilocular radiolucency	Enucleation & endodontic surgery	Recurrence at 3 yr 8 mo: enucleation.
44/F	Anterior mandible, unilocular radiolucency	Enucleation	Recurrence at 3 yr 3 mo: curettage
85/F	Mandible, multilocular radiolucency	NA	NA
59/M	Anterior mandible, unilocular radiolucency	Curettage	No recurrence for 6 mo: lost to follow-up
44/M	Maxilla, unilocular radiolucency	Enucleation 9 years after diagnosis	No recurrence in 2 yr
19/M	Mandible, radiolucency	Enucleation	No recurrence
48/M	Mandible, radiolucency	Enucleation	No recurrence
45/M	Anterior mandible, unilocular radiolucency with sclerotic borders	Marginal mandibulectomy preserving inferior border	No evidence of disease for 20 yr
52/M	Maxilla, well-defined radiolucency	Maxilectomy	No evidence of disease for 14 yr
39/M	Anterior mandible, multilocular radiolucency	Enucleation, endodontics surgery	No evidence of disease for 10 yr

Chapter 7

Dentigerous (follicular) Cyst

DENTIGEROUS (FOLLICULAR) CYST

Dentigerous literally interpreted means "tooth-bearing" and is a good descriptive term for this cyst which by definition is one which encloses the crown of an unerupted tooth lying within bone, and cannot be assigned to any other classification. Rarely the crowns of two or more teeth may be enclosed within one cyst cavity. Less rarely one patient may have more than one dentigerous cyst at the same time.

The relationship between cyst and tooth crown is quite precise so that the wall of the cyst is attached to the cervical region of the tooth and encloses the entire crown.

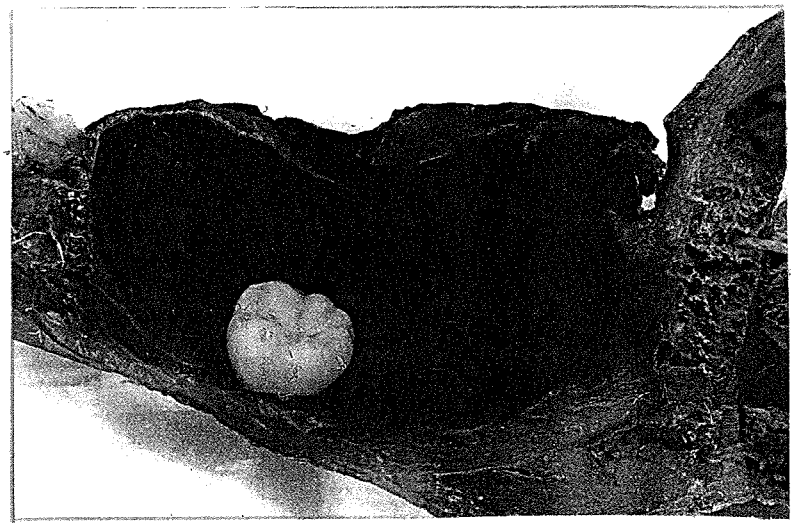

Figure 7.1 Gross specimen of a dentigerous cyst involving the mandibular third molar tooth.

As a consequence, the radiological appearance of the lesion is characteristic. However, it is not pathognomonic and a variety of other odontogenic cysts and tumours can produce a similar radiological image. Over the years the term dentigerous cyst has been loosely applied to any lesion producing an appropriate radiographical appearance. This usage is wrong and, indeed, misleading as lesions with a variety of different pathogenesis such as adenomatoid odontogenic tumour, odontogenic keratocyst, unicystic ameloblastoma may thus be included. The term should be reserved only for any cyst fulfilling the definition referred to in the above paragraph. If a cyst enclosing the crown of an associated unerupted tooth fulfills the histological criteria for the diagnosis of an odontogenic keratocyst (follicular primordial cyst)[79], that lesion should be classified as an odontogenic keratocyst and not a dentigerous cyst.

Whatever the pathogenesis of dentigerous cysts, a consistent feature is the presence of an epithelial-lined cavity attached to the neck of the tooth. Such a finding indicates that the cystic change must have arisen either within the reduced enamel epithelium itself or between it and the tooth surface but not within the connective tissue of the tooth follicle. The term follicular cyst may therefore be misleading.

Incidence

Although it is the most common developmental odontogenic cyst, the dentigerous cyst nevertheless has a low incidence. In Shear's series[89] of 2616 jaw cysts, 433 were dentigerous, that is 16.6 per cent.

Age and Sex

Although dentigerous cysts occur in the first decade more commonly than do other jaw cysts, the frequency in that period is nevertheless lower than in the subsequent three decades (Fig. 7.2). This is because the lower wisdom tooth and the maxillary permanent canines, which are the teeth most frequently involved in dentigerous cysts are at an early stage of development.

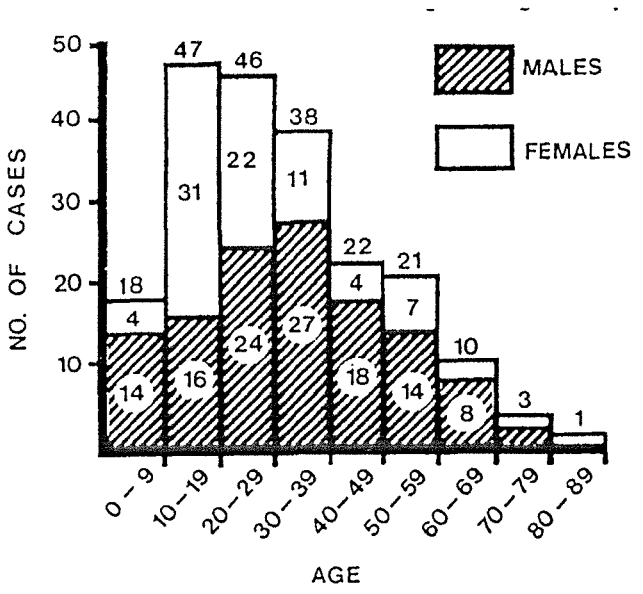

Figure 7.2 Age distribution of 206 patients with dentigerous cysts (Shear)

In the second decade, there is a substantially higher frequency than in the first, most of the cysts involving the maxillary permanent canine, the mandibular wisdom tooth and the upper and lower second premolars. The third and fourth decades show the peak involvement of the lower wisdom

teeth and it is during the third decade that the upper wisdom tooth becomes involved for the first time. During the subsequent decades there is a gradual decline in frequency with the mandibular wisdom teeth and maxillary permanent canines.

The frequency of dentigerous cysts is significantly greater in males than females with a ratio of 1.6 to 1 reported in Shear's study. These figures were found to be similar to other studies[106,107].

Clinical Features

Whites seem to have a greater tendency to develop dentigerous cysts. Most cysts are found during routine radiographic examination. They vary greatly in size from little more than the diameter of the involved crown to expansions that cause progressive but painless enlargement of the jaws with facial asymmetry, Teeth adjacent to the developing cyst, as well as the involved tooth, may be severely displaced. Most cysts occur in an area where a tooth has failed to erupt.

Dentigerous cysts may originate from unerupted supernumerary teeth[108] and they have also been observed in association with odontomas. Dentigerous cysts may occasionally be painful particularly if they become infected.

Radiological Features

Radiographically, the dentigerous cyst presents as a well defined, usually unilocular radiolucency in association with the crown of an unerupted tooth. Occasionally a multilocular appearance may occur. In actuality, the various compartments are all united by the continuous cystic membrane.

Figure 7.3

Sometimes the radiolucent area is surrounded by a thin sclerotic line representing bony reaction.

Three radiological variations of the dentigerous cyst may be observed. In the central variety the crown is enveloped symmetrically (Fig. 7.4).

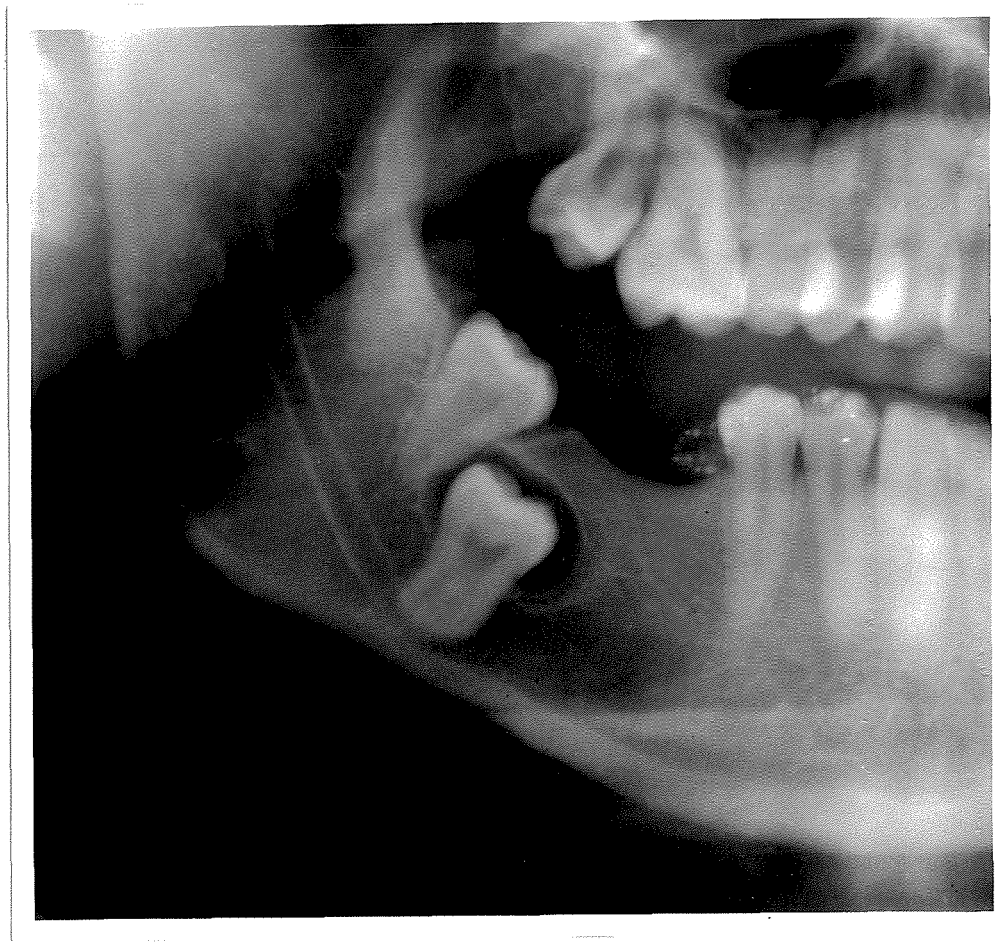

Figure 7.4 Radiograph of a central type of dentigerous cyst involving a mandibular molar tooth.

When the cyst develops at the side of the tooth and extends away from it, so that only a portion of the crown is within the cavity it is regarded as the

lateral type. This type is usually seen when an impacted mandibular third molar is partially erupted so that its superior aspect is exposed. Still another type is the circumferential dentigerous cyst in which the cyst surrounds the entire tooth. Here the enamel organ around the neck of the tooth becomes cystic, often giving the appearance of the tooth having erupted through the cyst.

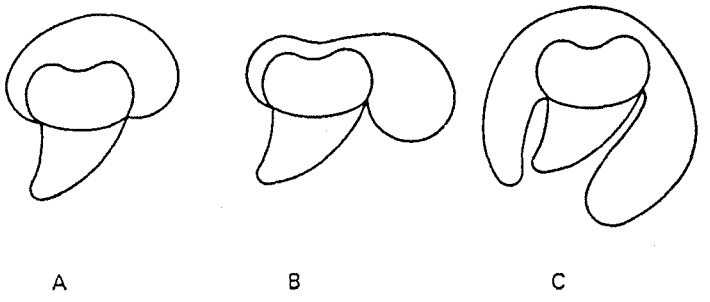

Figure 7.5 Diagram illustrating the manner in which the dental follicle may expand to produce the radiographic appearances of [A], central; [B], lateral; and [C], circumferential type dentigerous cysts.

The dentigerous cyst has a greater tendency than the other jaw cysts to produce resorption of the roots of adjacent teeth. In a radiographic study of root resorption produced by jaw cysts, Struthers and Shear[109] observed root resorption in 11 of 20 dentigerous cysts; that is 55 per cent. They suggested that a possible reason for the dentigerous cyst's potential for root resorption may be based on the fact that this cyst is derived from the dental follicle of a tooth which is prevented from erupting; and the ability of the follicle to resorb the roots of the deciduous predecessors.

The Dentigerous Cyst as a potential Ameloblastoma

In recent years a number of workers have referred to the occurrence, in part of a dentigerous cyst lining, of a mural nodule of proliferating epithelium which closely resembles a plexiform ameloblastoma[110-112]. The nodule protrudes into the cyst cavity and varies in size but generally shows either no, or only limited infiltration into the connective tissue capsule. Gardner[112] regarded these lesions as ameloblastoma although he suggested that they require only conservative treatment. Shear[113] has addressed the question of origin of ameloblastoma from dentigerous and other cysts and has pointed out that although dentigerous cysts are rare in blacks in South Africa, ameloblastomas are relatively much more common. He stated further that those cases reported in the literature as arising from existing odontogenic cysts may have been misinterpreted for a variety of reasons. Even the finding of a lesion around the neck of an unerupted tooth does not denote origin of that lesion from the follicle since Altini and Cohen[114] have demonstrated experimentally that teeth may erupt into adjacent cystic lesions.

Chapter 8

Eruption Cyst

ERUPTION CYST

An eruption cyst forms in the mucosal soft tissues overlying the crown of an erupting tooth; it occurs when a tooth is impeded in its eruption within the soft tissues overlying the bone.

Clinical Features

Eruption cysts are not commonly seen in pathology departments, and in Shear's series only 0.7 per cent of 2616 jaw cysts were registered. It is known that they occur more frequently clinically, in fact, Seward[115] has reported that this is a relatively common lesion occurring in 11 per cent of infants during eruption of the incisors. A possible explanation to this is that as some of the lesions burst spontaneously, these are not excised and are therefore not submitted for histological examination.

Clinically, the lesion appears as a circumscribed, fluctuant, often translucent swelling of the alveolar ridge over the site of the erupting tooth.

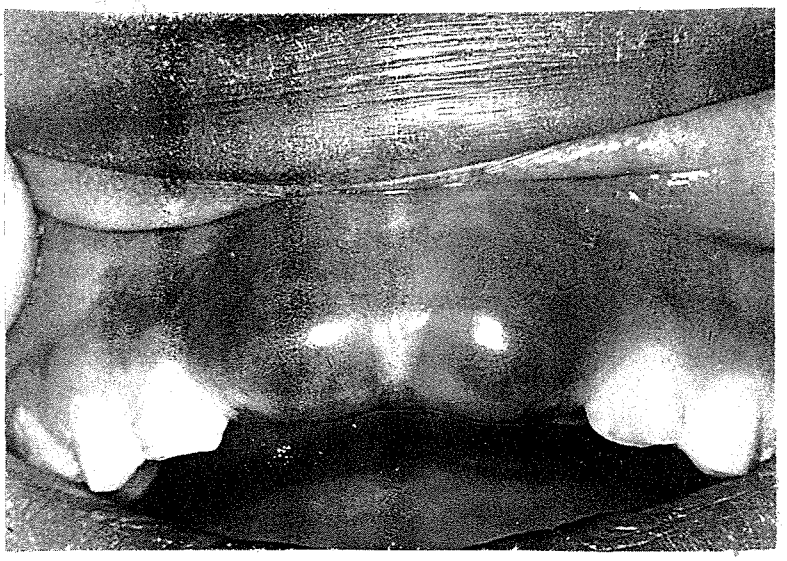

Figure 8.1 Eruption cysts involving the permanent maxillary central incisors.

When the circumcoronal cystic cavity contains blood, the swelling appears purple or deep blue; hence the term "eruption haematoma".

No treatment is needed because the tooth erupts through the lesion. Subsequent to eruption, the cyst will disappear spontaneously without complication.

Chapter 9

Gingival Cysts of Infants

GINGIVAL CYSTS OF INFANTS

These developmental cysts occur in newborn infants up to three months of age and, according to Fromm[116] are found on the crests of the maxillary and mandibular dental ridges. They are usually multiple, occasionally solitary, nodules and represent cysts originating from remnants of the dental lamina. The eponyms "Epstein's pearls" and "Bohn's nodules" have both been applied to this odontogenic cyst but incorrectly so.

Nelson[117] described Epstein's pearls as accumulations of epithelial cells on the hard palate on either side of the raphe. These are probably derived from entrapped epithelial remnants along the line of fusion. Bohn's nodules are keratin-filled cysts scattered over the palate, most numerous along the junction of the hard and soft palate and apparently derived from palatal salivary gland structures.

Occasionally these dental lamina cysts become sufficiently large to be clinically obvious as small discrete white swellings of the alveolar ridge, sometimes appearing blanched (Fig 9.1).

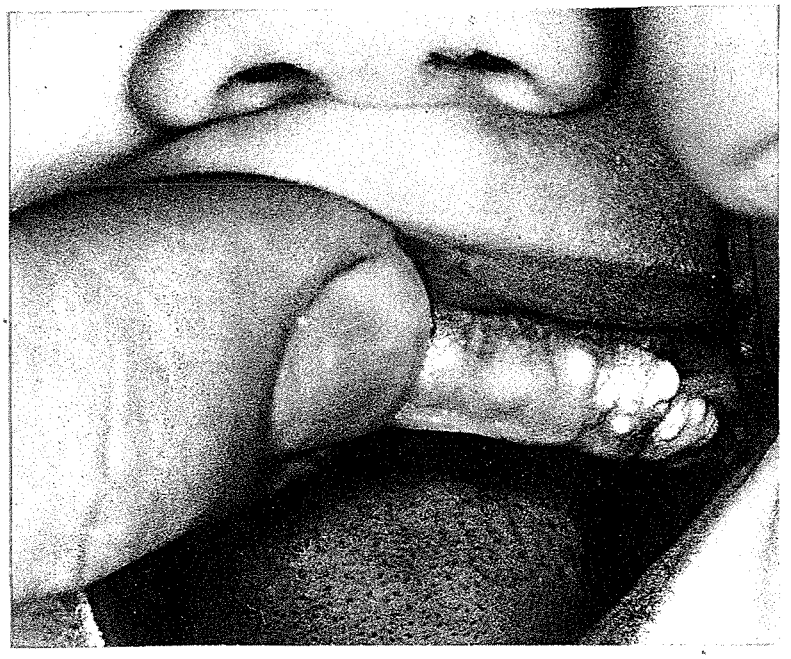

Figure 9.1 Gingival cysts in an infant.

As already described there is histological evidence that these cysts arise from the remnants of the dental lamina. In the normal process of tooth development, the dental lamina, from which the individual tooth germs are derived, undergoes fragmentation into a number of apparently discrete rests of stratified squamous epithelium. A number of these demonstrate differentiation of keratinizing squames towards the center of the rests, which process may progress to the formation of discrete keratin-filled cysts. The number of these cysts increases up to the 22nd week of foetal life [118]. These small cysts usually involute, in one of two ways, before reaching clinically detectable size. Most commonly, there may be fusion between the epithelium of the cyst lining and the overlying mucosa so that the keratin contents of the microcysts is discharged and the cyst involutes. Less

frequently the epithelial cells lining the microcysts break down, thus exposing the keratin contents of the cyst to the surrounding connective tissue. As a consequence, macrophages are attracted to the area where they digest the keratin, often in the process forming multinucleate giant cells, so that the residue involutes completely. Occasional cysts persist however, and enlarge to produce the gingival cysts of the newborn evident clinically, but eventually themselves involute as above. This process of epithelial atrophy is apparently complete by the third month postpartum.

Chapter 10

Nasopalatine duct (incisive canal) Cyst

NASOPALATINE DUCT (INCISIVE CANAL) CYST

The epithelial-lined cysts of non-odontogenic origin are thought to be derived from embryonic epithelial residues in the nasopalatine canal and, in the opinion of some workers, from epithelium included in lines of fusion of the embryonic facial processes. The latter view is controversial, as many embryologists and pathologists discount the possibility of such an origin, stating that the grooves between the processes are smoothed out by proliferation of the underlying mesenchymal growth centres, a process referred to as "merging". According to Allard [119,120] in only a few areas do developmental processes make ectoderm to ectoderm contact with subsequent ectodermal degeneration.

It is generally agreed that the nasopalatine duct cyst is an entity. It may occur within the nasopalatine canal or in the soft tissues of the palate at the opening of the canal, where it is sometimes called the cyst of the palatine papilla.

Incidence

The nasopalatine duct cysts are the most common nonodontogenic cysts in the oral region[89,120]. Of the cysts recorded in the department of Oral Pathology, Johannesburg, in 1983 not Shear[89] found 11.7 per cent to be nasopalatine duct cysts. Studies on cadavers, performed by Chamda and

Shear[121] have shown the total incidence of nasopalatine duct cysts to be 1.3 per cent. Killey et al[122], however, in the examination of 2394 skulls, detected only 2 nasopalatine duct cysts. Burket[123] studying 35 human necropsy specimens, found nonodontogenic cysts in the anterior maxillary region in 33 per cent of them. Stafne et al[124], and Abrams[125] have mentioned an overall incidence of 1 per cent. An incidence of 1 per cent was found in the local study.

Age and Sex

Nasopalatine duct cysts are usually discovered in patients between the fourth and sixth decades of life[89,126]. The mean age has been reported as being from 31 to 54 years[127,128]. In a survey of 70 cysts, Bodin et al[129] reported a mean age of 45 years.

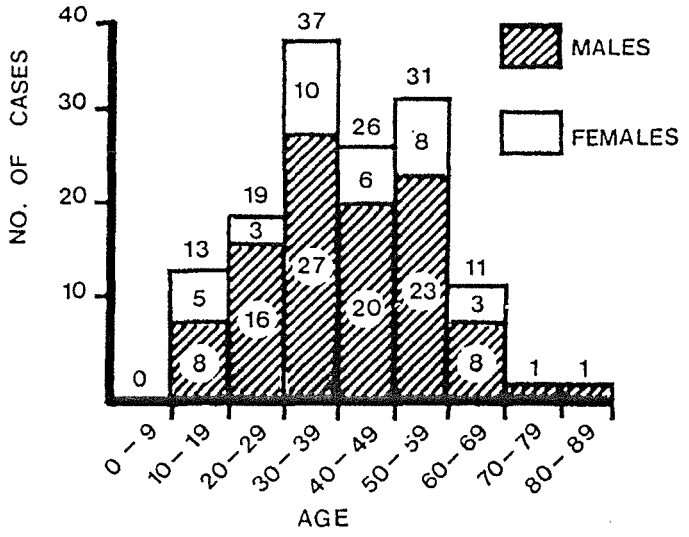

Figure 10.1 Age distribution of 139 patients with nasopalatine duct cysts.

This agrees with another larger survey of 334 nasopalatine cysts made by Kimberly et al[130] who found the mean age at diagnosis to be 42.5 years, with no significant difference between the ages of males or females and blacks or whites at the time of diagnosis.

Most of the available literature reports a male predilection. Anneroth et al[127] reported a male to female ratio of 1.7:1 in 35 cases. In a series of 51 cysts, Nortje et al[131], found 64.7 per cent of the cases in males. A slightly higher male to female preponderance of 3.1:1 was recorded in the study of Shear[89]. On the other hand in the series of Abrams et al[126] there was an equal sex frequency.

Clinical Features

Most nasopalatine duct cysts are reported to be asymptomatic. Occassionally, the cyst manifests itself by a swelling in the midline of the anterior palate. In rare cases a 'through and through' fluctuation between a palatal and a labial swelling can be observed[132]. Seldom is the cyst facially disfiguring; bulging into the nasal cavity and distortion of the caudal portion of the nasal septum and base of the columella have been reported[133].

Although pain is uncommon, the cystic expansion within the incisive canal may exert pressure on the nasopalatine nerves, which is believed to be one of the causes of this symptom, especially in cases of secondary infection. Due to intermittent drainage, these symptoms are often less severe and may persist for a long time before the patient seeks treatment. The discharge may be mucoid, in which case the patients sometimes describe a salty taste, or it may be purulent and patients complain of a foul taste.

In general, symptoms are not severe and patients often disregard them for many years; cases present for 15 years have been reported[124]. They may also be completely symptomless, and be discovered fortuitously by the dentist during routine radiological examination. In establishing a diagnosis of nasopalatine duct cyst it is important to attempt to exclude the possibility of a periapical lesion by testing the vitality of the pulp of the incisor teeth.

Radiological Features

The nasopalatine duct cyst occurs in the incisive canal and the radiological differentiation between a cyst and the normal anatomical incisive fossa can be difficult. In his study of 2162 skulls, Roper-Hall[134] concluded that the maximum diameter of a large incisive fossa was 6 mm; and a shadow less than 6mm wide may be considered to be within normal limits, provided the patient has no symptoms. Chamda and Shear[121], however, in their study on skulls of blacks found a width up to 8mm to be normal. Aspiration might be helpful in distinguishing between a normal large incisive fossa and a cyst; as well as contrast radiography[122,135].

Abrams et al[126] stated the following characteristics to be an aid in differentiating between a true cyst and a normal foramen:

1. The superior margin of a cyst appears to be higher on radiographic examination than that of a fossa.
2. The margin of a cyst is better defined than that of a fossa, and
3. Cysts are spherical more often than fossae.

The contours of the cyst are round, ovoid or pear shaped. Since the pear shape is thought to be caused by the resistance of the roots of the teeth, such cysts are considered to be present in the oral part of the incisive canal, the round ones being located more nasally[136]. Sometimes the cyst may appear heart shaped because it becomes notched by the nasal septum.

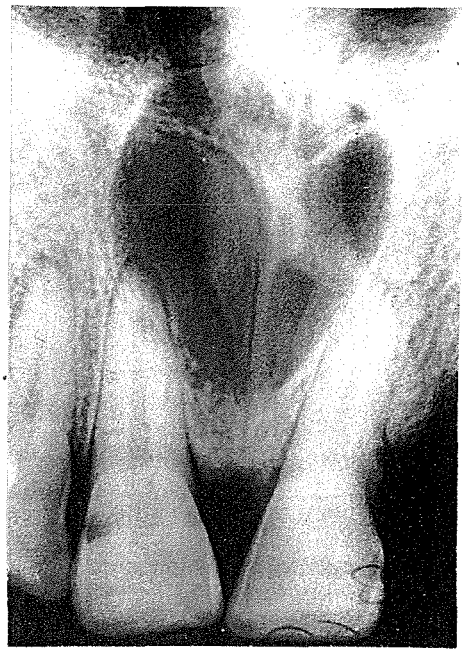

Figure 10.2 Radiograph of a nasopalatine duct cyst. The lamina dura of the tooth on the left is intact although the apex appears to be in the cyst.

It is also possible that the nasal spine is superimposed on the radiolucent area, or that there are bilateral cysts from both nasopalatine ducts. Cystic development of only 1 of the ducts explains the presence of a nasopalatine duct cyst outside the midline.

The lamina dura around the tooth apices is intact. Root resorption, caused by osteoclastic activity initiated by the cyst pressure, is rarely seen[131]. In very large cysts, expansion may cause displacement of the roots of the central incisors. Calcification of the contents of the cyst has also been described[137].

In general the occlusal view gives a good impression of the lesion, but in very high nasally located cysts, the orthopantomogram demonstrates these better[131].

The radiological investigation of nasopalatine duct cysts by tomography has been described by Lysell and Molin[138]. Hertzanu, Cohen and Mendelsohn[139] suggested that computed tomography appeared to be of value in the investigation of large lesions with destruction of bone and posterior and intranasal extension.

Chapter 11

Nasolabial (nasoalveolar) Cyst

NASOLABIAL (NASOALVEOLAR) CYST

The nasolabial cyst is a soft-tissue developmental epithelial cyst which characteristically occurs as a swelling in the nasolabial fold at the base of the alae of the nose. As a result of enlargement they may present in the floor of the nose and in the upper labial sulcus of the mouth.

The nomenclature of the nasolabial cyst has followed two main trends, some authors using a nomenclature related to the supposed aetiology, while others have named the cyst according to its location. It has been referred to by many names, some of the more common ones being nasoalveolar cyst, nasal vestibule cyst, nasal wing cyst and mucoid cyst of the nose[119].

Although a rare condition, many reviews including several large series have added to our understanding of this lesion[140,141]. The cyst is thought to arise from the lower anterior part of the nasolacrimal duct, either from epithelial cell rests or from the proliferation of entrapped epithelium during embryogenesis[142,143].

Most of the controversy concerning this lesion lies in the theories of its pathogenesis. In 1913, Klestadt[17] suggested that the nasolabial cyst arose from epithelium entrapped at the point where the maxillary, medial nasal, and lateral nasal processes fuse. From his concept came the term fissural cyst[144]. Due to the lack of evidence for embryonic epithelial entrapment in this region, however, and the fact that the lesion is located subjacent to the wing

of the nose, it was subsequently suggested that development may be in the line of the naso-optic fissure, from the base of which Streeter[145] has shown proliferation of the nasolacrimal duct. Bruggemann et al[146] suggested the origin of the nasolabial cyst from the lower part of the nasolacrimal duct, and Rold-Peterson[143] also subscribed to this concept.

Bilateral cysts have been reported to occur in about 10 per cent of the cases[141]. It comprises about 0.7 per cent of all jaw cysts[141], and between 200 and 300 cases have been reported in the literature[119,141].

Age and Sex

It occurs within a wide age distribution with peak frequencies in the fourth and fifth decades[141,143] (Fig 11.1). Significantly more females are affected than males[119,141]. In the sample of Van Bruggen et al[141] 119 patients were females, that is 79 per cent and 32 males, that is 21 per cent. It has been suggested that the cyst is more prevalent among black persons[147].

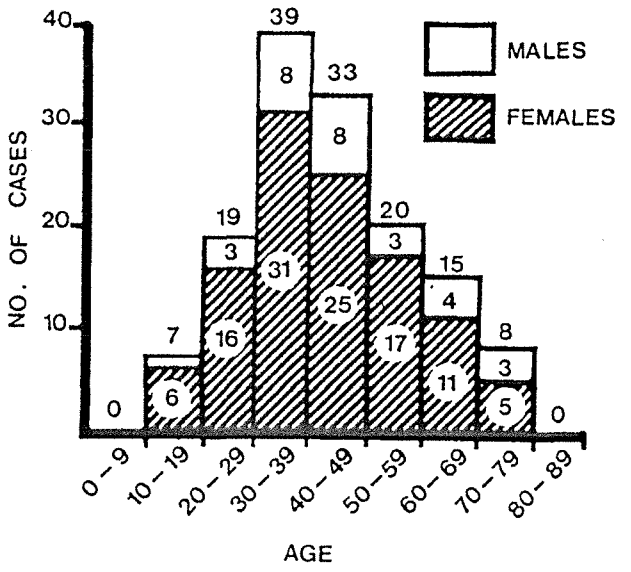

Figure 11.1 Age distribution of 141 patients with nasolabial cysts.

Clinical Features

The clinical features of the nasolabial cyst are fairly typical. Patients usually complain of a swelling adjacent to the nose. In some cases the cyst may be discovered on routine examination. A swelling in the maxillary buccal sulcus may prevent the seating of a denture. Unless an infection develops, pain is not usually a feature. The cyst grows slowly, producing a swelling of the lip; and may cause obliteration of the nasolabial fold and elevation of the alae of the nose. Swelling of the floor of the nasal vestibule may be obvious. The cyst is fluctuant and is best palpated bimanually with one finger on the floor of the nose and one finger in the labial sulcus.

Radiological Features

Nasolabial cysts are primarily soft tissue lesions so that they may not be apparent on a radiograph; it sometimes causes erosion of the underlying maxillary bone which may be seen radiologically. Seward[148] has described features on standard occlusal radiographs which he found to be typical of the nasolabial cyst. He pointed out that there is a localised increased radiolucency of the alveolar process above the apices of the incisor teeth. This radiolucency results from a depression on the labial surface of the maxilla which may be detectable on a tangential view.

Differential Diagnosis

From a differential diagnostic point of view, several lesions can produce the same clinical features as a nasolabial cyst. First, there is a possibility of nasal furunculosis. In contrast to an infected nasolabial cyst, furunculosis of the nose is accompanied by a very throbbing pain, shows a more reddened and, when the condition is well advanced, a yellow-coloured mucosa, and has a shorter history. A radicular cyst may present on occasion as a swelling within the mucobuccal fold in this region; vitality tests of the adjacent teeth are helpful in this case. Odontogenic cysts of the non-inflammatory type may also rarely present in this fashion.

Chapter 12

The Median Palatine, Median Alveolar, Median Mandibular and Globulomaxillary Cysts

THE MEDIAN PALATINE, MEDIAN ALVEOLAR, MEDIAN MANDIBULAR AND GLOBULOMAXILLARY CYSTS

Median Palatine and Median Alveolar Cysts

In recent years, the existence of separate entities of median palatine and median alveolar cyst has been questioned and they have been excluded from the World Health Organization Classification (Kramer, Pindborg and Shear 1992). Previously it was thought that these cysts developed from epithelium entrapped in the process of fusion of embryonic processes. It is now thought that they represent posterior extension of an incisive canal cyst in the case of median palatine cyst, and anterior extension in the case of median alveolar cyst. The so-called median alveolar cyst may also, in a number of instances, be a keratocyst derived from dental lamina in the midline of the maxilla.

If a median posterior palatine cyst does exist it would be necessary to postulate its origin as being by enlargement of a midpalatine raphe cyst, or from epithelial inclusions in the region. The contingency of this occurring is remote. The midpalatine raphe cysts and the epithelial inclusions lie close to the palatal epithelium. It seems unlikely that a median palatine cyst could develop in this site and produce extensive bone resorption without forming a large palatal swelling at a very much earlier stage of its natural history.

Shear has re-examined the histological sections of 15 cases which were diagnosed as median palatine cysts prior to 1968. He found that the histological features would be consistent with a diagnosis of nasopalatine duct cysts.

As far as the median alveolar cyst of the maxilla is concerned, Sicher[147] was convinced that there is no embryological basis for assuming that it develops from epithelium enclosed at the site of fusion between the right and left globular processes. "Such a fusion" said Sicher, "simply does not occur".

Median Mandibular Cyst

There is still confusion about the existence of the median mandibular cyst as a pathologic entity, although cysts do occur in the midline of the mandible, just as they do throughout the rest of the jaws. The only reason that would justify the continued recognition of the median mandibular cyst as a 'fissural cyst' would be evidence that epithelium could become entrapped in the midline of the mandible during fusion of the two halves of the mandibular arch during embryogenesis. This possibility, however, has been disproved[148]. The mandible develops from the single core of mesenchyme of the first branchial arch . It consists of two centers of mesenchymal proliferation with an isthmus of mesenchyme between them. They gradually increase and spread until the furrows are smoothed out and the isthmus is thereby eliminated. There is thus, no fusion of epithelium-covered processes and no chance of epithelial entrapment. There are still those, however, who argue otherwise. Allard[119] has cited Patten[149] who

stated that if, during the process of merging, the mesenchyme inferior to the dividing groove becomes relatively inactive and the mesenchyme in the protruding eminences continue to grow at a normal or accelerated rate, the ectodermal surfaces could come into contact and form a source of fissural epithelium.

Tanimoto et al[150] analysed 12 cases of cysts in the median mandibular region and believed that all could be either keratocysts, solitary, lateral periodontal or radicular cysts. Gardner[151] surveyed 20 reported cases of median mandibular cyst and concluded that all could be odontogenic cysts and that the median mandibular cyst does not exist as a separate entity.

Globulomaxillary Cyst

The globulomaxillary cyst has been a subject of confusion and controversy in the dental literature since it was first reported by Thoma[152] in 1937. Each of the two cysts he described produced a pear-shaped radiolucent area between the divergent roots of the maxillary lateral incisor and canine; the teeth were vital in one case, non-vital in the other. One cyst was lined with stratified squamous epithelium, no information was given about the histology of the other. Thoma also postulated that both lesions arose from the non-dental embryologic epithelium of the fissures between the developing facial processes.

On the basis of embryologic evidence, Sicher[153] subsequently stated that the development of a globulomaxillary cyst was not possible since the globular

portion of the medial nasal process is an integral part of the maxillary process and epithelial entrapment between the two processes therefore could not occur.

Combining a comprehensive review of the literature and the embryologic evidence presented by Sicher[153] and others[19,154], Christ[30] carried out a clinico pathologic correlation of a series of radiolucencies occurring in the globulomaxillary region. On the basis of his study, Christ concluded that the globulomaxillary cyst should be removed from the classification of orofacial fissural cysts since most, if not all, cysts in this anatomic site were odontogenic rather than fissural in origin.

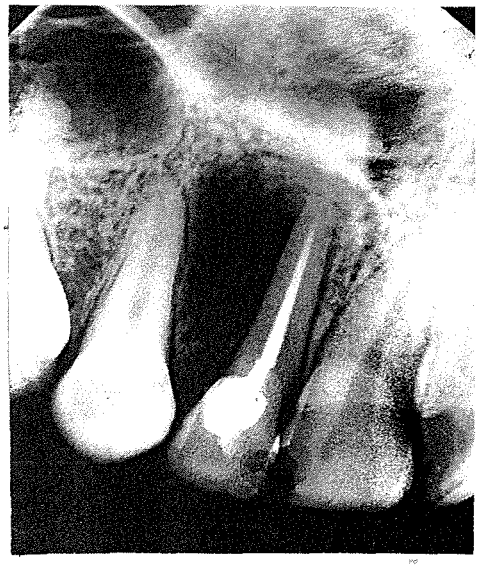

Figure 12.1 Radiograph of a lateral radicular cyst, arising from a non-vital maxillary lateral incisor, in the globulomaxillary area.

Wysocki[32] came to the same conclusion following his analysis of 37 cases which had been diagnosed clinically as globulomaxillary cysts.

Table 12.1 An analysis of globulomaxillary radiolucencies (37 cases)

Clinical Diagnosis	Histopathologic Diagnosis	No. of cases
Globulomaxillary cyst	Radicular cyst	19
Globulomaxillary cyst	Periapical granuloma	6
Globulomaxillary cyst	Lateral periodontal cyst (developmental)	4
Globulomaxillary cyst	Odontogenic Keratocyst	3
Globulomaxillary cyst	Central giant cell granuloma	3
Globulomaxillary cyst	Calcifying odontogenic cyst	1
Globulomaxillary cyst	Odontogenic myxoma	1

Other lesions such as the adenomatoid odontogenic tumour, ameloblastoma and haemorrhagic bone cyst have also been reported in the

globulomaxillary region and misdiagnosed as such on clinical and radiological grounds. Kuntz and Reichart[155] have reported a case of an adenomatoid odontogenic tumour simulating a globulomaxillary cyst and Vedtofte and Holmstrup[156] have described a series of inflammatory cysts in the globulomaxillary region which they considered to be paradental cysts.

Little and Jakobsen[157] have suggested that the globulomaxillary cyst could have a dual origin and might arise from either odontogenic or nonodontogenic epithelium. While this is an intriguing question, most of the evidence presently available leads to the conclusion that the so-called globulomaxillary cyst is not an entity but that a variety of cysts and tumours can occur as well-demarcated radiolucent lesions in the lateral incisor-canine region of the maxilla.

Chapter 13

Radicular cyst, Residual cyst and Paradental cyst

INFLAMMATORY ODONTOGENIC CYSTS

Radicular and Residual Cyst

A radicular cyst arises within a focus of inflammation in the periodontium derived from the root of a nonvital tooth. These cysts usually occur in association with the apical foramen of the root or roots of the nonvital tooth. Consequently, the terms periapical cyst or apical periodontal cyst have been widely used. However, rarely, the cyst occurs in association with the foramen of a laterally placed root canal in which case it lies laterally to the root of the nonvital tooth. For this reason, the term radicular cyst is preferable as it includes all cysts with a common pathogenesis irrespective of their anatomical relationship to the causative tooth.

Residual radicular cysts are those inflammatory periodontal cysts that persist after removal of the associated non-vital tooth. They represent approximately 10 per cent of all odontogenic cysts[33, 122]. Compared with other cyst types, they appear to have received little attention in the literature.

Molyneux[158] studied inflammatory changes along with epithelial atrophy in residual cysts and surmised that repair followed removal of the inflammatory irritant. Oehlers[58] carried out a radiographic study of 168 presumed residual cysts, left *in situ* for periods of up to 7 years and

concluded that most lesions resolved, while a small percentage remained static. No cases increased in size.

High and Hirschmann[160, 161] have reported studies on two series of asymptomatic and symptomatic residual cysts. With regard to the symptomatic cysts, they showed that there was a decrease in size with increasing age. Nevertheless, they do persist, and the authors did not provide evidence for complete resolution.

Incidence

Radicular and residual cysts are by far the most common cystic lesions in the jaws, comprising 1368 or 52.3 per cent of 2616 jaw cysts in Shear's study[89] . This is a lower frequency than the figure of 68 per cent in the series of Killey, Kay and Seward[122]. An incidence of 60.7 per cent was found in the present study . This compares well with Shear's series.

Age and Sex

Very few cases are seen in the first decade, after which there is a fairly steep rise, with a peak frequency in the third decade. There are large numbers of cases in the fourth and fifth decades after which there is a gradual decline[62, 89] (Figure 13.1). 0f interest is the relative rarity of radicular cysts in the first decade even though caries and non-vital teeth are rather frequent in this age group.

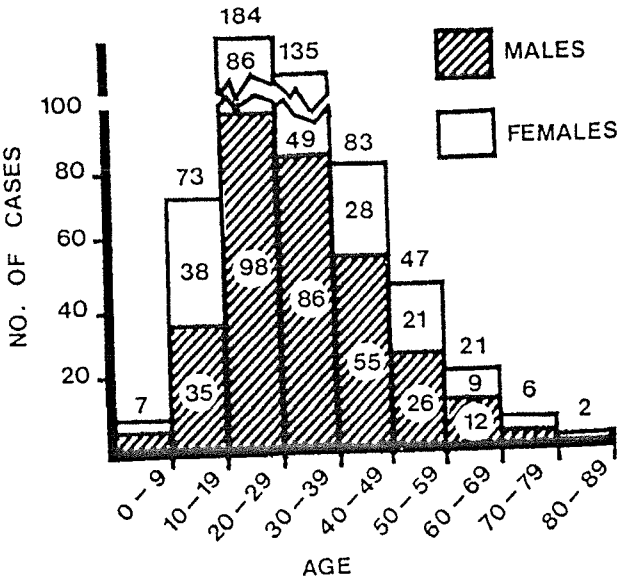

Figure 13.1 Age distribution of 558 patients with radicular cysts.

A majority of cases, approximately 60 per cent have been noted in males. The lower frequency in females may be because they are less likely to neglect their teeth, particularly the maxillary anterior incisors, in which area most radicular cysts occur. Moreover, males are more likely to sustain trauma to their maxillary anterior teeth.

Radicular cysts occur in all tooth bearing areas of the jaws although in many studies 60 per cent have been found in the maxilla and 40 per cent in the mandible with a particularly high frequency of 35-40 per cent in the maxillary anterior region[62, 89].

Clinical Features

The majority of cases of radicular cysts are asymptomatic and present no clinical evidence of their presence; their discovery is usually by chance during routine radiography. The tooth is seldom painful or even sensitive to percussion. This type of cyst is only infrequently of such a size that it destroys much bone. A sine qua non for the diagnosis of a radicular cyst is the related presence of a tooth with a non-vital pulp. Occasionally, a sinus may lead from the cyst cavity to the oral mucosa.

Although it is usual for only one tooth to be associated with a radicular cyst at any one time, there is a small number of patients in whom more than one radicular cyst may be present or who develop more than one cyst over a period of time[30, 32]. Such patients may have a genetic predisposition to epithelial hyperplasia and cyst formation, although there is no firm evidence for such a hypothesis[159]. This view is supported by the fact that radicular cysts are relatively rare in relation to the vast numbers of grossly carious teeth with dead pulps. It is also possible that an immune mechanism may inhibit cyst formation in most individuals and cyst-prone subjects may have a defective immunological surveillance and suppression mechanism[162].

Over the years, the opinion that radicular cysts arising from deciduous teeth are rare, has been commonly held. This view has been supported by the rarity with which such cases have been published. In an extensive review of the literature by Lustmann and Shear[163] only 28 cases were found. The incidence is probably higher than these figures would suggest. Sprawson[164]

stated that radicular cysts arising from deciduous teeth are less often seen than those from permanent teeth, because of the much shorter time that the deciduous teeth are present in the jaws. It may be thought that the good drainage which occurs when deciduous teeth are infected, would reduce the probability of cyst formation.

Radiological Features

A well-defined, circular radiolucency with hyperostotic borders at the apex of a grossly carious or heavily restored tooth is highly characteristic (Figure 13.2). The periodontal ligament space is typically continuous with the apical radiolucency.

Figure 13.2 This well-defined radiolucency, apical to the grossly carious root tips of the lower first premolar, represents a radicular cyst.

The cyst as already described, may also be located on the lateral aspect of the root in association with a lateral canal.

In infected or rapidly enlarging cysts the radio-opaque margin may not be present. In long-standing cysts, root resorption of the offending tooth and occasionally adjacent teeth may be noted.

Radiographically, there are no distinctive differences between a radicular cyst and a periapical granuloma. In the past, undue emphasis was placed on the presence of a thin radiopacity at the circumference of the radiolucent lesion. This, once thought to indicate a cyst, has proved not to be the case, since periapical granulomas can present with a similar if not identical radiographic appearance. Size also is not an accurate indicator of the cyst versus granuloma diagnosis.

A widely accepted early view of McCall and Wald[165] was that periapical cysts could be differentiated radiographically from granulomas on the basis of their larger size - more than 9.5 mm in diameter, and their possession of a radiopaque cortex. Grossman[166], taking a somewhat more cautious view, suggested that while radiographic differentiation of cysts and granulomas was possible in most cases, small radicular cysts could not always be differentiated from granulomas.

A number of studies have been carried out to determine the reliability of radiographic identification and differentiation of periapical cysts and granulomas[167-172] .

In all of these studies, evaluators judged the presence of cysts or granulomas from radiographs alone or from radiographs plus clinical data. The accuracy of their judgments was determined by subsequent histologic examination. The results of these studies suggested that radiographic criteria used to differentiate cysts and granulomas were unreliable[100, 172] although data from a number of these same studies indicate a considerable correlation between increased size of radiographic lesions and the incidence of cysts[170, 171].

Bhaskar[169] however, in a major study of the incidence of periapical lesions observed a lack of correlation between lesion size and cyst incidence.

Table 13.1 Reported incidence of periapical cysts and granulomas in various studies

Study	Lesions	Cysts		Granulomas		Other	
	no.	no.	%	no.	%	no.	%
Priebe et al (1954)	101	55	54	46	46	0	0
Sommer et al (1956)	170	11	7	143	84	16	9
Baumann & Rossman (1956)	121	32	26	89	74	0	0
Wais (1958)	50	13	26	32	64	11	10
Linenberg et al (1964)	110	31	28	68	62	11	10
Patterson et al (1964)	510	70	14	420	84	20	2
Bhaskar (1966)	2308	969	42	1108	48	231	10
Lolande and Luebke (1968)	800	350	44	361	45	89	11
Morse (1973)	43	10	23.2	33	76.8	0	0
Winstock (1980)	9804	824	8.4	8176	83.3	813	8.3
Stockdale & Chandler (1988)	1108	186	16.8	856	77.3	66	5.9

The reported relative incidence of cysts in various studies of periapical lesions is shown in Table 13.1. Earlier assumptions that the incidence was low[173, 174] have been replaced by the now generally accepted view of a higher incidence[170-175]

Differences in incidence from study to study can be accounted for by the differing influence of a number of significant variables[176, 177]. Among these are histological criteria used for identification of cysts[178]. In the various studies cited in Table 13.1, many investigators required the presence of an epithelium-lined lumen for designation of lesions as cysts[169,179]. Differing degrees of variation from this requirement were also reported[171, 175], and in one study[170] histologic criteria were not specified.

Carcinomatous Change

Neoplastic transformation in the epithelial lining of an odontogenic cyst is a rare but well-described phenomenon. Herman[180] first described malignant transformation in an odontogenic cyst in 1889. Gardner[181] reviewed all documented cases from 1889 to 1967, and determined that there were 25 acceptable instances of malignant transformation within the epithelial lining of an odontogenic cyst. In 1975 Eversole et al[182] updated Gardner's list by increasing the number of acceptable cases to 36. More recently a review of the literature was carried out by Schwimmer et al[183].

The neoplasms associated with epithelial cyst lining include ameloblastoma, squamous cell carcinoma, and mucoepidermoid

carcinoma[182]. In evaluating an odontogenic cyst for the occurrence of a primary malignancy, several other possibilities have to be excluded, such as invasion of the cyst wall from an adjacent primary or metastatic carcinoma and cystic degenerative change in a primary or metastatic carcinoma. The histopathologic criteria employed to document malignant transformation of the cyst lining is identification of a transition from the normal lining epithelium to dysplasia, carcinoma in situ, and, eventually, infiltrating carcinoma[181, 184].

Long-standing chronic inflammation has been proposed as the principle predisposing factor of the malignant transformation in the epithelial lining of the cyst, yet cannot be substantiated. Several reports emphasize that keratinization of the lining epithelium is more often associated with a high risk of malignant transformation[185-187].

The most common cyst undergoing malignant change has been the residual cyst, constituting 55 per cent of all cases[183]. Keratinization in the epithelial lining of a cyst has been demonstrated in approximately 18 per cent of all cases. Despite the undoubted examples which occur from time to time, the frequency of neoplastic change is exceptionally rare in relation to the large numbers of cysts which are seen.

Paradental Cyst

The paradental cyst is an odontogenic cyst of inflammatory origin, which occurs on the buccal, distal or rarely mesial aspects of partially erupted and

impacted mandibular third molar teeth. In most cases there is an associated history of recurrent pericoronitis and absence of generalized periodontal disease. This lesion was first described by Main[33, 188] who used the term inflammatory collateral cyst.

Craig[34] has given a detailed account of an inflammatory cyst that occurs on the buccal and distal aspects of the root of a partially erupted mandibular third molar in cases in which there is a history of pericoronitis. The cysts were lined with a hyperplastic, nonkeratinized stratified squamous epithelium, and an intense inflammation was present in the connective tissue of the cyst wall. Craig[34] suggested the term paradental cyst for this clinicopathologic entity, which he considered the same as the inflammatory collateral cyst described by Main[33].

Shear[89] is in agreement with the term paradental cyst, and regards the term inflammatory collateral cyst as being appropriate for those rare cysts that arise in periodontal pockets.

Craig's paper on the paradental cyst was, for a number of years, the only detailed account of the entity. Recently, however, three papers on the subject have been published which corroborate Craig's observations - Ackermann, Cohen and Altini[189], Fowler and Brannon, 1989[190] and Vedtofte and Praetoruis 1989[191].

Stoneman and Worth[192] described a lesion that is possibly related to the paradental cyst, but which occurs primarily in children and arises buccal to vital mandibular first molars in most cases. They referred to this lesion as

the "mandibular infected buccal cyst". Its radiographic appearance is identical to the paradental cyst with the exception that buccal periostitis is usually seen on an occlusal radiograph.

Packota et al[193] reported five more cases and added that the term mandibular infected buccal cyst should be discouraged since it is a clinical description and not a specific diagnosis.

Incidence

The relatively low frequency of this lesion recorded both in Ackermann's[189] and Craig's[34] study namely 3 and 5 per cent suggests that the paradental cyst is a rare lesion. It is generally believed that its true incidence is substantially greater than this. According to Ackermann et al[189], in many centers these cysts are being called dentigerous cysts.

Age and Sex

Virtually all the cases in the study by Ackermann et al[189] occurred between the ages of 10 and 39 years with two-thirds of their sample in the third decade; the same as in Craig's material[34]. Fowler and Brannon[190] reported a similar incidence.

The preponderance of this lesion in males reported by Craig[34] - 83 per cent, was also corroborated by Ackermann, Cohen and Altini and Fowler and

Brannon, whereas in the material of Vedtofte and Praetorius[191], there was an equal sex distribution.

Clinical Features

Analysis of the literature confirms that the majority of paradental cysts occur during the third decade of life. There is also a preponderance of cases in whites and males. Most of the lesions are associated with mandibular third molars and a history of pericoronitis. All the cases of Fowler and Brannon[190] and in the majority in Craig's series[34] , the cysts were located adjacent to the buccal root surface, covering the bifurcation. This is in contrast to the series of Ackermann and associates[189], in which the majority of the cysts were located distal or distal and buccal to the crown of the tooth.

The chief complaint in most cases of paradental cyst in children affecting the mandibular first molars is buccal swelling[191, 192, 194]. Buccal swelling in the cases reported appears to be caused by cystic expansion, inflammatory periostitis or a combination of both[191, 192, 194]. It is probably more common in children Because the cortex is thinner in the first molar region compared with the second or third molar, and the periosteum in children is more reactive. because buccal swelling occurs rarely, if at all, in cases involving the second or third molars, this feature is important in diagnosing paradental cysts in the first molar area in children[195].

Radiological Features

Radiographically the most common finding is that of a well-defined radiolucency in a position predominantly distal to the involved tooth but with a variable buccal extension (Figure 13.3).

Figure 13.3 (a and b) Two cases of bilateral paradental cysts associated with erupting mandibular third molar teeth.

In most cases, the radiolucencies mimic periapical pathology, however, on closer inspection, it is evident that the periodontal ligament space is intact and the radiolucent lesion is actually superimposed over the roots of the involved tooth.

Chapter 14

Aneurysmal Bone Cyst

NON-EPITHELIAL CYSTS

There are two entities that do not easily fit into any classification. These are the solitary bone cyst and the aneurysmal bone cyst. Neither of these is a true cyst in the sense of having an epithelial lining, but they are invariably classified as cysts in textbooks of pathology and radiology.

Aneurysmal bone cyst of the jaws

The aneurysmal bone cyst is a lesion of bone consisting generally of several cavities filled with blood and deprived of an endothelial lining. It is most common in the long bones and vertebrae[196] but it has been also reported in the clavicle and rib as well as in other bones. In these locations it has been associated with benign conditions such as giant cell tumour, chondroblastoma, chondromyxoid fibroma, and fibrous dysplasia and with malignant tumours including osteosarcoma, chondrosarcoma, and malignant endothelial tumours[197].

The lesion occurs as a benign, localized, solitary swelling, the development of which may vary from a few weeks to several years. The word 'aneurysmal' was originally used to describe the 'blown-out' appearance of the contour of the affected area. Jaffe and Lichtenstein[198] in 1942 reported the existence of a peculiar type of blood-containing cyst in their article describing

the unicameral bone cyst. But only in 1950 did Lichtenstein[199]and Jaffe[200] independently describe the aneurysmal bone cyst as a separate entity.

Incidence

The first report of aneurysmal bone cysts involving the craniofacial skeleton appears to be that of Bernier and Bhaskar[201]. Aneurysmal bone cysts of the jaws are rare. By 1986, the number of reported cases had reached 61[202,203]. In Shear's study[89], 12 cases occurred over a 32-year period representing only 0.5 per cent of 2616 jaw cysts.

Age and Sex

The aneurysmal bone cyst in the head and neck region is primarily a lesion of younger age groups; most cases occurring in the first three decades of life, with a peak in the second decade[89]. However, several cases in older individuals exist in the literature.

There appears to be a slight predilection for females. Struthers and Shear[204], in an extensive review of the literature on the aneurysmal bone cyst of the jaws of 42 well-documented cases, found that 62 per cent occurred in females.

In the study of El Deeb et al[205] females were affected in 53 per cent of the cases and males in the remaining 47 per cent.

Site Distribution

Most reports cite a predilection of the aneurysmal bone cyst for the mandible, especially in the body and ramus region[197,204]. Struthers and Shear[204], in their review of 46 cases, found that 28 occurred in the mandible; that is 61 per cent and 18 in the maxilla. One cyst was found close to the orbital floor and another in the zygomatic arch. The anterior region of the mandible was rarely involved. Most of the cases were located in the molar regions of the mandible and maxilla and a number of the mandibular cases extended posteriorly to involve the angle and ascending ramus.

Clinical Features

Taljanic and colleagues[203] in their review of the lesion claimed that the common clinical presentation was a swelling of the soft tissues overlying the bony lesion. Pain does not appear to be a significant feature of these lesions. When it does occur, however, some authors ascribe it to stretching of the overlying tissues, or to secondary infection.

The swelling and malocclusion frequently become progressively worse and the rate of enlargement is often described as relatively rapid. When the lesion perforates the cortex and is covered by periosteum or only a thin shell of bone, it may exhibit springness or egg-shell crackling, but is not pulsatile.

According to the patients' histories, trauma does not seem to play a significant aetiological role[206].

Radiological Features

The radiological features of aneurysmal bone cyst are not characteristic and diagnosis cannot be made on a radiographic basis alone. The lesion appears as an expansile cystic mass that is usually unilocular, although it may be multilocular (Fig 14.1).

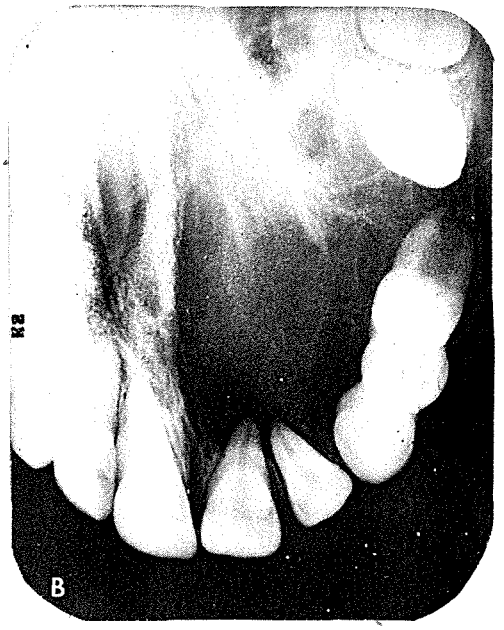

Figure 14.1

As the lesion increases in size, there may be marked expansion and thinning of the cortex, resulting in a "ballooning" or "blowout" "honeycomb" or "soapbubble" appearance that is noticeably abnormal[207]. If the lesion involves the region of the teeth, root resorption may be seen[207]. The teeth may be displaced, but remain vital.

Chapter 15

Solitary Bone Cyst traumatic, simple and haemorrhagic bone cyst

SOLITARY BONE CYST
(TRAUMATIC, SIMPLE, HAEMORRHAGIC BONE CYST)

The simple bone cyst appears in the literature under a multiplicity of names, these include - traumatic bone cyst, solitary bone cyst, haemorrhagic bone cyst, progressive bone cavity, extravasation cyst, simple bone cyst, idiopathic bone cavity, and solitary bone cavity[208]. It is not classified as a true cyst because the lesion lacks an epithelial lining and is often found empty on surgical exploration.

The aetiology of this lesion remains obscure, although a number of theories have been proposed. Howe[209] and Sieverink[210] have carried out extensive reviews of the literature and pointed out the wide acceptance of the theory of origin from intramedullary haemorrhage following traumatic injury. However, the frequency with which a history of trauma may be elicited varies between different series of cases. For example, in a group of 30 cases of traumatic cyst of the jaws reported by Beasley[211] only 27 per cent of the patients gave a history of trauma, while in a series of 66 cases reported by Hansen[212] and his co-workers, approximately 80 per cent of the patients indicated a preceding traumatic episode.

A more recent suggestion has been made by Hosseini[213]. He proposed that solitary bone cysts might result from a failure of differentiation of osteogenic cells. Hosseini suggested that instead of developing into bone or cartilage, mesenchymal cells might form synovial tissue. The solitary bone

cyst might therefore originate as multiple bursa-like synovial cavities which later coalesce to form a larger connective tissue-lined defect. Such an origin would account for the irregular outline of the lesion.

Incidence

The solitary bone cyst is not a common lesion. Only 26 specimens were recorded in Shear's[89] study of 2616 jaw cysts, representing a frequency of 1 per cent. There were 19 cases in the series of 3353 jaw cysts reported by Hoffmeister and Harle[214], a frequency of 0.6 per cent.

Age and Sex

The traumatic bone cyst occurs most frequently in young persons, the median age being 18 years in a series of 45 cases reviewed and reported by Gardner and Stoller[215]. According to Howe[209], over 75 per cent of cases occur in the second decade of life. In the series of Hansen, Sapone and Sproat[212] the age range was 7-75 years and more than half of the cases occurred in the second decade. The ages of the patients in the personal series of Kaugars and Cole[216] ranged from 9-68 years with a mean age of 24.3 years.

Howe[209] recorded a male to female ratio of 1.6:1 in his analysis of 60 cases.

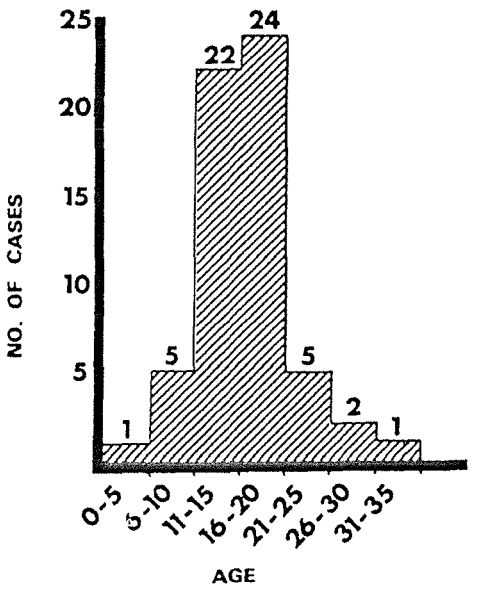

Figure 15.1 Age distribution of 60 patients with solitary bone cysts of the jaws (After Howe 1965).

In the most recent review carried out by Kaugars and Cole[216] there was an equal sex distribution; they concluded that "this discredits the concept that trauma is the sole causative factor if one accepts the hypothesis that males experience traumatic injury more frequently than females".

Clinical Features

Although it has been stated that the posterior portion of the mandible is more commonly involved than the anterior[212] numerous cases have been reported in the incisor region. The maxilla has been known to develop the solitary bone cyst, usually in the anterior region. The traumatic bone cyst is

asymptomatic in most cases but on occasion there may be evidence of pain or tenderness. In some cases enlargement of the mandible has been observed but often the lesion is discovered during routine radiographic examination of the patient. In the series of Howe[209], only 35 per cent of cases showed expansion, and this was the most common complaint causing patients to seek treatment. When bone swelling is reported it is generally mild, the surface is smooth, and the cortical plates are not disrupted. In the majority of cases the pulps of the teeth in the involved area are vital. When the cavity is opened surgically, it is frequently found to be empty. In other cases, blood, serosanguinous, or serous fluid may be present.

Multiple lesions have been present in 11 per cent of reported cases[216].

Radiological Features

The classic appearance of the traumatic bone cyst is of a solitary radiolucency of variable size with well-defined margins which may or may not be sclerotic, depending upon the duration of the lesion. When the radiolucency appears to involve the roots of the teeth, the cavity may have a lobulated or scalloped appearance extending between the roots of the teeth.

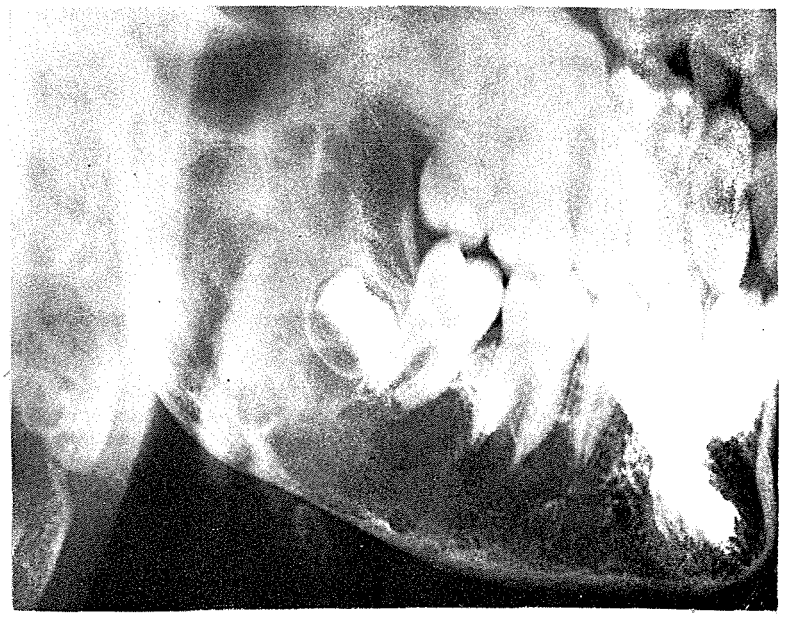

Figure 15.2 Solitary bone cyst involving the body of the mandible and the ramus in a patient 12 years of age.

The lamina dura may or may not be lost and occasional root resorption may occur. Many authors admit that the size, shape and margins can be quite variable. Jacobs[217] called these lesions "great imitators". Morris and co-workers[218] described "a multiplicity of disguises". Reports of lesions in the maxilla have not been very descriptive of the radiographic features. Most reports of lesions in this location cite the anterior maxilla as the site of predilection when the upper jaw is involved. Marlin and associates[219] described a maxillary lesion with a scalloped outline surrounding the incisors and premolars that had a "corticated border in some areas".

Chapter 16

Differential Diagnosis of Cysts

DIFFERENTIAL DIAGNOSIS OF CYSTS

As described previously, cysts of the jaws tend to have a classical appearance as a well defined round or oval area of radiolucency circumscribed by a sharp radiopaque margin. However, there are many variations to this classical pattern which can be due to the type of cyst and/or location and the degree of expansion and destruction of the cyst.

Although the majority of radiolucent lesions will prove to be cysts or granulomas, the alert practitioner must remember that a number of pathologic processes may present clinical and radiological findings similar, if not identical, to these common lesions. Some of these pathologic lesions may have a more serious prognosis than the common dental cyst and must be treated accordingly. Others are relatively innocuous but must be recognised to prevent unnecessary sacrifice of teeth.

Circumscribed areas of radiolucency in the jaws may be due to the following causes:

1. Normal anatomical structures

(a) In the maxilla: i) Nasal fossa
ii) Incisive foramen
iii) Maxillary sinus

b) In the mandible: i) Mental foramen

2. Cysts

3. **Neoplasms,** particularly ameloblastoma

Common anatomical radiolucent appearances

In an article regarding the interpretation of anatomic radiolucencies McCauley[220] had this to say: "the interpretation of radiographs of the teeth and jaws is an extremely uncertain procedure when attempted without a complete knowledge of the normal anatomic structures involved and their radiographic appearance. The reason for this is simple: it is only by consideration of the normal that the abnormal can be distinguished. Consequently, the radiographic diagnosis of dental pathologic conditions is dependent on a clear understanding of the structural characteristics and landmarks common to normal human jaws".

Maxilla

Nasal fossa

Since the air-filled nasal fossa lies just above the oral cavity, its radiolucent image may be apparent in intraoral radiographs of the maxlllary teeth, especially the central incisor projection (Fig. 16.1).

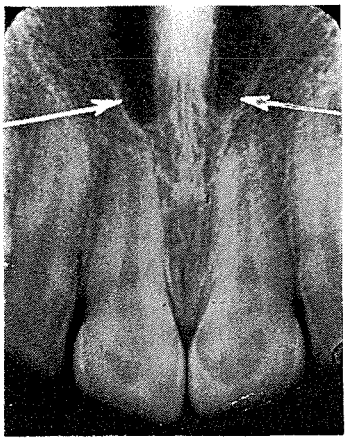

Figure 16.1 Periapical radiograph showing nasal fossa

Only portions of the fossae are usually seen, the dark area usually is not of uniform density owing to the fact that the inferior portion of the inferior turbinate bones occupies part of the nasal fossa. In extra-oral projections the nasal fossae are roughly pear-shaped.

Incisive foramen

The incisive foramen lies in the midline on the palatal side of the central incisor teeth at approximately the junction of the median palatine and incisive sutures. Its radiographic image is usually projected in the midline between the roots and in the region of the middle and apical thirds of the central incisors. Its radiographic image varies markedly in shape, size, and

sharpness. It may appear smoothly symmetrical with numerous forms or very irregular in shape and with a well demarcated border or with one that is ill-defined.

The incisive foramen is a potential site of cyst formation. An incisive canal cyst is radiographically discernible because it frequentJy causes an enlargement of the foramen and canal that is readily perceived.

If the radiolucency of the normal foramen is projected over tie apex of one of the central incisors, it may suggest a pathologic periapical condition. Figure 16.2

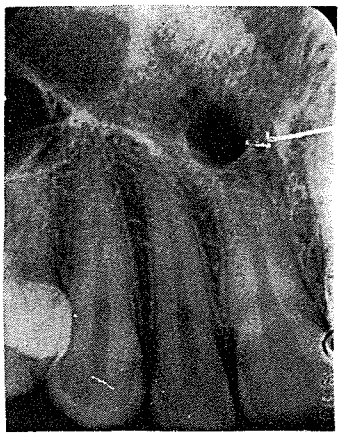

Figure 16.2 Incisive foramen projected over the apex of the central incisor

Maxillary Sinus

Maxillary sinuses vary greatly in size, some being so small that evidence of their existence does not appear in the dental radiograph. Other maxillary sinuses are so large that they extend well down into the interseptal spaces of the posterior maxillary teeth and the region of the tuberosity. Being an air cavity it is revealed in radiographs as a dark shadow. Figure 16.3

Figure 16.3 Periapical projections showing the maxillary sinus

Difficulty might sometimes arise in deciding whether a patient's radiographs reveal the presence of a cyst or merely the maxillary sinus. No one radiographical sign is infallible in distinguishing between the two types of cavity and in all cases of difficulty it may be necessary to look at the problem from a number of different aspects before assessing the evidence.

Symmetry of the maxillary sinuses

While asymmetry is not uncommon, nevertheless the maxillary sinuses are often symmetrical and if any asymmetry is present than the extension should be carefully scrutinized.

The periphery

If a cavity in the maxilla is separated from the cancellous bone by a white cortical line it is likely to be the maxillary sinus, but if there is no white line then the cavity is likely to be a cyst. Further, the lamina dura almost always separates the roots of healthy teeth from the antrum, but is frequently destroyed where a cyst expands to involve their apices.

An important diagnostic landmark is the Y-shaped line of Ennis. The forking limbs of the Y-formation delineate the anterior wall of the sinus swinging away from the lateral wall of the nose. A horizontal continuation posteriorly of the line of junction of the lateral wall and the nasal floor is represented by the long leg of the letter Y. Effacement or modification of the typical pattern may follow cystic development and growth in the area.
The maxillary sinus expands into the alveolar process from above whilst a cyst originates within the alveolar process. A small maxillary sinus intruding into the ridge will have only a short antero-posterior dimension, but in periapical films it's floor will be high up. A cystic cavity having a similar short antero-posterior diameter is likely to lie lower in the alveolar process and its upper boundary will be detectable in suitable films.

Further views

In doubtful cases it is best to obtain further views, such as the occipito-mental view in which the whole of the maxillary sinus can be studied.

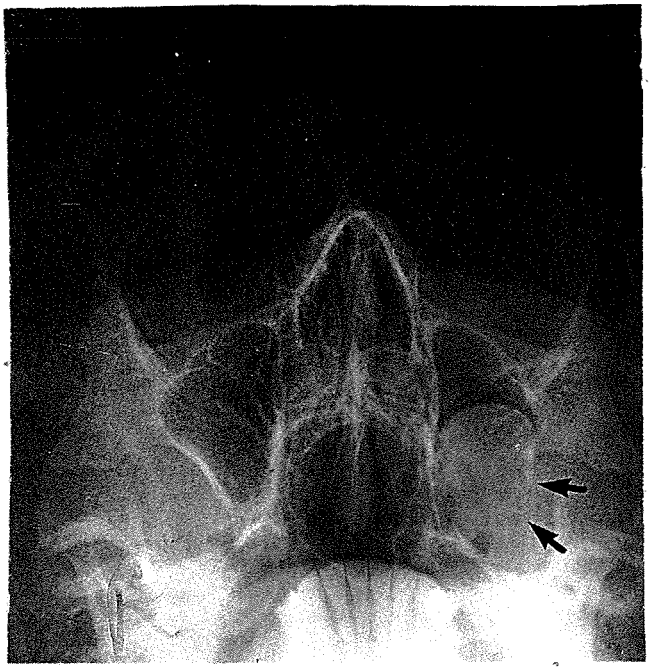

Figure 16.4 A cyst in the edentulous left maxilla which has expanded the lateral wall (arrows) and floor of the antrum, forming a relatively radiopaque, dome-shaped mass projecting into it.

A fluid filled cyst will appear as an opaque shadow in the occipito-mental view, with a bold, rounded outline and a periphery slightly more opaque than the rest. Expansion of part of the wall of the sinus may also be present. Figure 16.4

A mucous cyst of the antrum should be distinguished from an odontogenic cyst. The former is usually dome-shaped, uniformly radiopaque and well defined, without the presence of a white marginal line. It does not displace the walls of the antrum as may an odontogenic cyst. Further, if an occipito-mental film is taken with the head tilted laterally, the mucous cyst will alter in shape.

Bret-Day's[221] view is that a dental cyst expanding the antral floor would give a similar appearance to a secretory cyst, but the angle formed by the antral floor and cyst wall would be less acute.

Mandible

Mental Foramen

The mental foramen is usually the anterior limit of the inferior dental canal that is apparent on a radiograph; its image is quite variable. Although the wall of the foramen is of cortical bone, the density of the foramen's image will vary, as will the shape and definition of its border. It may be round, oblong, slit like or very irregular and partially or completely corticated. The foramen is seen about halfway between the lower border of the mandible and the crest of the alveolar process, usually in the region of the apex of the second premolar. Also, because the foramen is on the surface of the mandible, the position of its image in relation to the tooth roots is influenced by projection angulation.

When the image of the mental foramen is projected over one of the premolar's apices, it may mimic periapical pathosis.

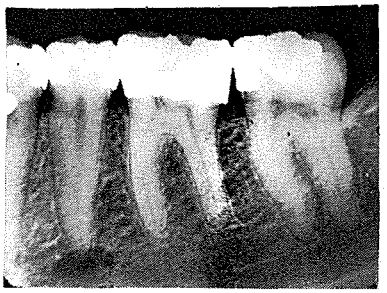

Figure 16.5 Periapical radiograph showing the mental foramen in relation to the root of the premolar tooth.

Evidence of the inferior dental canal extending to the suspicious radiolucency or a detectable lamina dura in the area will suggest the true nature of the dark shadow.

Periapical Conditions

A small discrete periapical granuloma may resemble an apical periodontal cyst, but frequently the periphery of the lesion is less sharply demarcated than that of a cyst and it does not always extend as abruptly away from the surface of the root.

Tumours and tumour-like lesions

Although these are not common, they must form part of the differential diagnosis of maxillary and mandibular pathologic conditions.

Classification of tumours that can present as a cyst-like radiolucency include:

Odontogenic (epithelial)	Ameloblastoma
	Calcifying epithelial odontogenic tumour (CEOT)
	Clear cell odontogenic tumour~
	Odontogenic carcinoma
	Ameloblastic fibroma
	Adenomatoid odontogenic tumour
	Calcifying odontogenic cyst
Odontogenic (mesenchymal)	Odontogenic fibroma
	Myxoma
Non-odontogenic intrinsic primary bone tumours	Benign - Fibroma; Chondroma; Osteoma; central haemangioma.
	Malignant - Osteosarcoma; Fibrosarcoma; Chondrosarcoma.
Extrinsic primary tumour involving bone	Squamous cell carcinoma
Secondary (metastatic) bone tumour	

Lymphoreticular tumours	Burkitt's lymphoma; Ewing's tumour
of bone	Multiple myeloma; Large cell lymphoma
Histiocytosis X	Eosinophilic granuloma; Hand-Schuller
	Christian disease; Letterer-Siwe disease

Almost any pathologic process may occur about the crowns of unerupted teeth, including primary and metastatic malignant tumours. These processes are rare and do not generally produce well-defined radiolucent lesions.

Most solid, slow-growing benign neoplasms tend to become rounded and compact initially, with a sharp margin. In cases where teeth are pushed apart, many such benign tumours are lobulated and have a partly crescentic outline. This is in contrast to the dental cyst which will only tilt or move teeth very late after nearly all the supporting alveolar bone has been lost. Solid lesions also commonly cause resorption of tooth roots.

Central haemangiomas are usually discovered on routine radiography, the appearance being that of an atypical radiolucent area with a soap-bubble or trabeculated appearance.

Primary malignancies may either cause a complete loss of local bone leaving an irregular, ragged or feathery margin, or infiltrate widely with little obvious bone destruction. Metastatic new growths are uncommon and are likely to be blood borne. A solitary metastasis will show an ill-defined radiolucency tending to originate centrally rather than at the alveolar

margin, and is usually in the third molar region or ramus of the mandible; sometimes multifocal deposits are present.

The ameloblastoma is an odontogenic tumour usually described as a locally malignant lesion and thought to arise from ameloblasts. It may cast a unilocular cyst-like radiolucency or a multilocular image. An ameloblastoma produces more extensive resorption of the roots of the teeth it comes in contact with than do most other lesions - Stafne[222]. If the ameloblastoma occupies a single, or monocystic cavity only, the radiographic diagnosis becomes increasingly difficult because of the resemblance to the dentigerous cyst and to residual epithelium-lined cysts. Figure 16.6 .

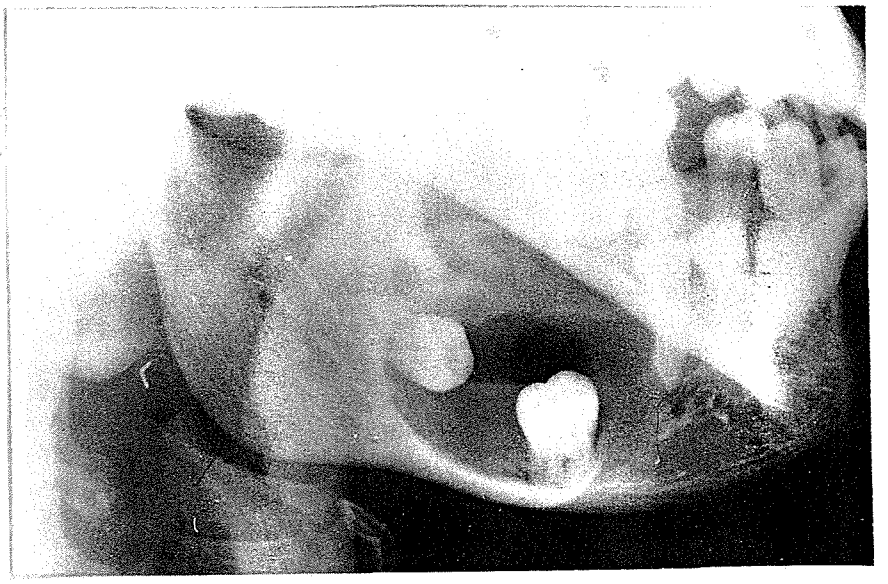

Figure 16.6 Ameloblastoma with the radiological appearance of a dentigenous cyst.

The adenomatoid odontogenic tumour is somewhat uncommon making up approximately 3 per cent of all odontogenic tumours according to the study reported by Regezi and co-workers[223].

It is most likely to be confused with a dentigerous cyst. Suggestive, but not absolute criteria for diagnostic consideration are the site, that is a tendency for the incisor - premolar region, the common association with an unerupted tooth, an early appearance of the majority in the second decade and sometimes scattered calcific bodies within the radiolucency.

Both the odontogenic fibroma and the odontogenic myxoma occur infrequently about unerupted teeth, and may have a radiolucent image.

The lesions of myeloma are classically multiple small "punched-out" radiolucencies with a well defined non-corticated margin, however, these radiological features are not consistent. The clinical picture, that is, recurrent back pain, progressive anaemia, weight loss, and tooth mobility together with the radiographic changes and biochemical evidence - Bence Jones protein in the urine contribute to a positive diagnosis.

In Hand-Schuller-Christian disease, multiple, punched-out osteolytic areas occur in the bones. It may provide a diagnostic pitfall in the case of the mandible or maxilla if there are no concomitant oral signs such as swelling, ulceration of the gums and extrusion of teeth. The eosinophilic granuloma is often single and appears more frequently in young children, particularly in the posterior region and angle of the mandible where it may simulate a dental cyst. The true nature of the pathological process may only be

discovered at operation and biopsy, but suspicious signs are marked mobility or spontaneous exfolation of teeth, gross pocketing and failure of sockets to heal.

Giant-cell Lesions

These include: 1) The central giant cell granuloma
2) Brown tumours in hyperparathyroidism
3) Cherubism

The central giant cell granuloma may occur initially as a solitary cyst like radiolucency, but as it grows larger, it frequently develops an architecture that causes a soap bubble type of multilocular radiolucency.

The brown tumour in hyperparathyroidism can occur as a unilocular or multilocular radiolucency. The establishment of its true identity is dependent on demonstrating the concomitant parathyroid, kidney or other systemic disorder along with abnormal serum calcium, phosphorous and alkaline phosphatase levels.

The multiple lesions occurring bilaterally in the ramus, coupled with the cherub appearance, the specific age group (between the ages of 2 and 20 years), and a history of kindred involvement, should readily guide the clinician to the correct diagnosis of cherubism.

Fibro-osseous lesions

These include: 1) Fibrous dysplasia
2) Ossifying/cementifying fibroma
3) Cementoma

Fibrous dysplasia

Among the .radiographic manifestations of fibrous dysplasia is the radiolucent pattern, due to fibrous tissue formation. This may have a cyst-like appearance bereft of a complete cortical rim; but if the bordering cortex is well-defined it tends to be wider than that of a cyst and there should be some bony structure, that is faint trabeculae, within the substance of the cavity. If the lesion involves the teeth, the lamina dura may sometimes be lost.

Ossifying/cementifying fibroma

The early stage of an ossifying or cementifying fibroma is osteolytic, in which the surrounding bone is resorbed and replaced by a fibro-vascular type of soft tissue containing osteoblasts or cementoblasts or both. Cementifying cementomas and ossifying fibromas at this stage may appear as solitary cyst like radiolucencies that are not in contact with teeth.

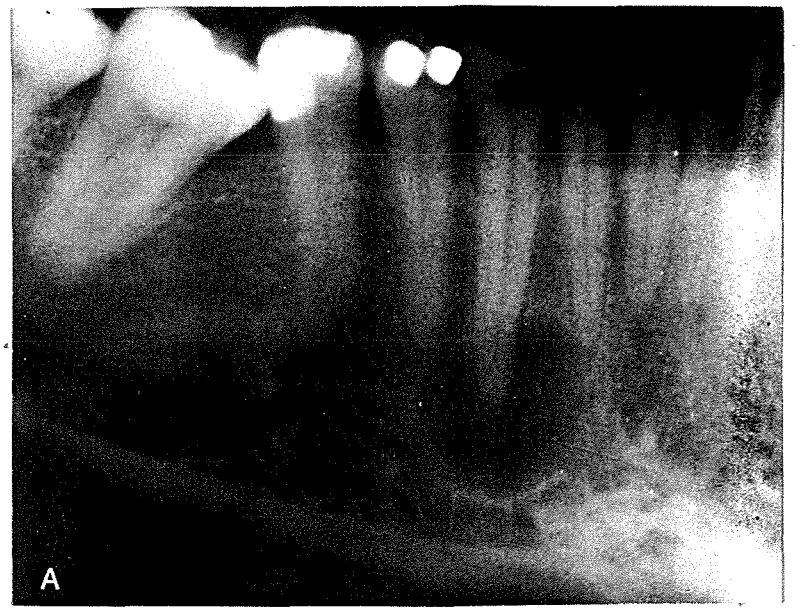

Figure 16.7 Cementifying fibroma appearing as a cyst like radiolucency resembling a periapical cyst

The majority of cementifying and ossifying fibromas will occur in the periapex because they originate from elements in the periodontal ligament. Occasionally, however, they will not be in contact with the roots of teeth but will occur in the body of the maxilla or mandible in edentulous areas or, when teeth are present, not be associated with the teeth.

Cementoma

A cementoma in its early lytic fibroblastic stage cannot be distinguished radiographically from a periapical granuloma or cyst. An early cementoma forms a connective tissue mass continuous with the periodontal membrane

of a tooth, and this is represented radiographically by a well-circumscribed radiolucency in the periapical region.

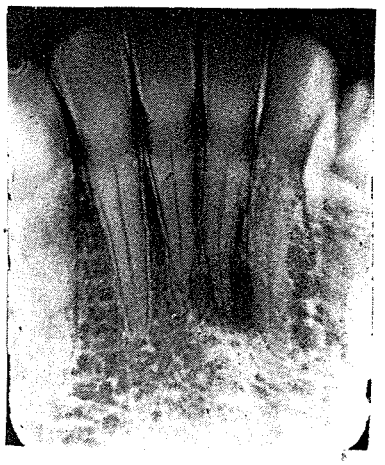

Figure 16.8 Cementoma of mandibular incisor showing the first or early stage of formation

Multiple occurrence in the mandibular incisor region suggests this diagnosis and the involved teeth will be of a normal colour and are vital. At a later stage there will, of course, be calcified spicules and eventually homogenous masses of cementum.

Chapter 17

Retrospective Study

CYSTS OF THE JAWS
A STATISTICAL STUDY

Cysts are one of the most common lesions in jaw pathology. As pointed out earlier, although epithelial cysts are extremely rare in other bones, they are found frequently in the jaws.

Statistical studies on cysts are usually taken from two sources: those prepared by radiologists and those made on the basis of records of a laboratory that specializes in oral pathology. Both of these sources tend to elude the true facts. The series based on radiographic data alone will include cysts and cyst-like lesions such as cystic forms of otherwise solid tumours. It is difficult to distinguish one from the other by radiographic examination alone. In general the data from oral pathology laboratories usually refer particularly to large cysts or to those where there was some difficulty in diagnosis during clinical examination.

A retrospective study of the cysts of the jaws that were found over a six-year period namely 1985 up to 1990, and which were treated at the Dental Department St Luke's Hospital Malta was carried out. This was done in order to establish a base line for future comparative studies.

Materials and Methods.

All the cysts seen during the years 1985 to 1990 were included in the study. All the clinical information as regards to age, sex, localization, radiographic aspect and histological features was noted.

RESULTS.

a) Incidence.

There were 107 patients with cysts of the jaws. Table 17.1 reveals the incidence of each variety of cyst. It is seen that the inflammatory group accounts for 61 per cent of the total number of cysts treated. The dentigerous cysts were next in order of frequency - 18.7 per cent.

TABLE 17.1		
Incidence of Cyst Types		
	No. of Cases	%
Inflammatory Radicular		
Apical & Lateral	56	52.3
Residual	9	8.4
Paradental	-	-
Developmental Odontogenic		
'Gingival cyst' of infants	-	-
Odontogenic keratocyst	9	8.4
Dentigerous (follicular) cyst	20	18.7
Eruption cyst	2	1.9
Lateral periodontal cyst	-	-
Gingival cyst of adults	-	-
Non-odontogenic		
Nasopalatine duct cyst	11	10.3

The preponderance of inflammatory cysts - 61 per cent agrees with most large surveys reported - Fickling[41], Killey and Kay[122], Shear[89], Cabrini et al[224], as does the percentage incidence 18.7 % of dentigerous cysts. The incidence

of keratocysts - 8.4 per cent approximates the figure of 11 per cent in Shear's study[89], as well as that of Browne[50], Payne[59], Craig[34] and Hodgkinson et al[225]~ as seen in Table 17.2.

TABLE 17.2

Author(s)	Material	%
Browne, 1970	41 of 537 odontogenic cysts	7.6
Payne, 1972	103 of 1313 odontogenic cysts	7.8
Craig, 1976	85 of 1051 odontogenic cysts	8.1
Hodgkinson et al, 1978	79 of 1100 jaw cysts	7.2
Present study, 1993	9 of 107 jaw cysts	8.4

b) Age Distribution.

The incidence of patients with cysts in the first decade was nil for all types with the exception of one case of the dentigerous variety; that is a 5 per cent incidence. This compares well with the result of Killey and Kay[122].

Peak incidence occurred in the second and third decades for patients with the inflammatory type of cysts as well as for the dentigerous variety. A peak in the fifth decade occurred for the keratocyst.

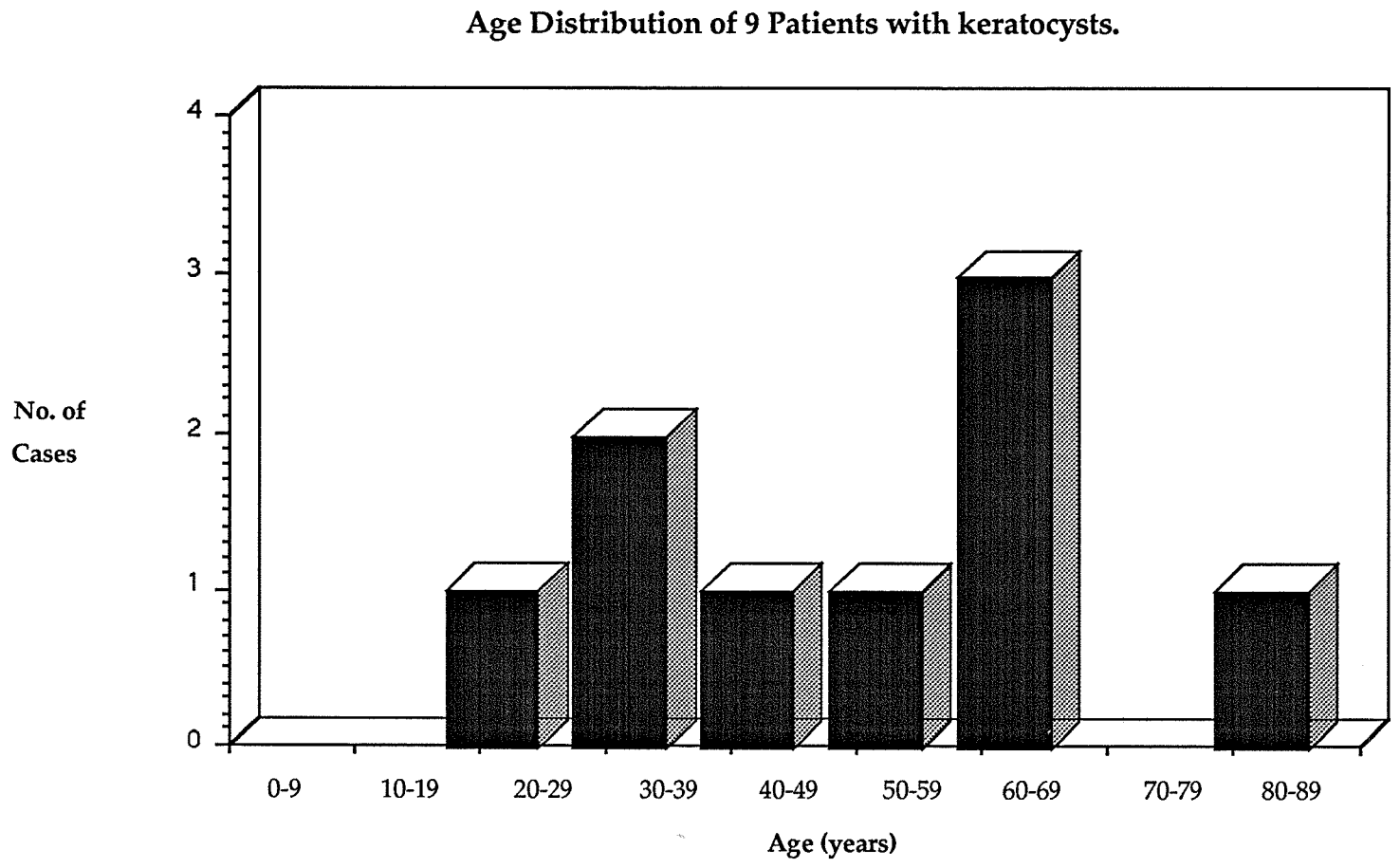
Age Distribution of 9 Patients with keratocysts.
No. of Cases
4
3
2
1
0
0-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
Age (years)

Figure 17.1

Figure 17.2 The radiolucent area associated with the decicuous right maxillary incisors represented a radicular cyst.

Figure 17.3 Radiograph of a residual cyst in an edentulous maxilla.

Figure 17.4 Radiograph of a residual cyst. This lesion must be differentiated from a keratocyst.

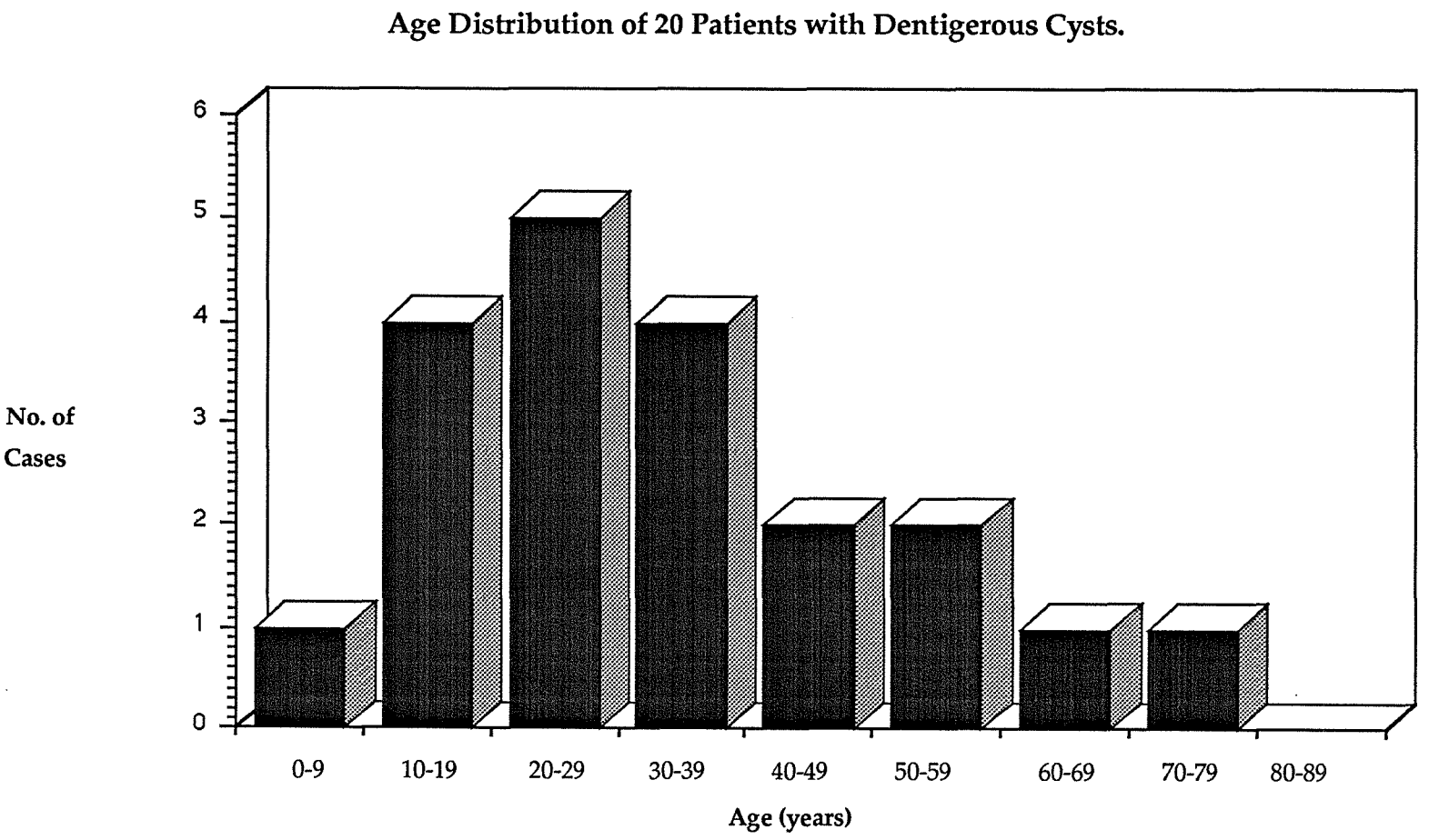
Age Distribution of 20 Patients with Dentigerous Cysts.
No. of Cases
0
1
2
3
4
5
6
0-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
Age (years)

Figure 17.5

Figure 17.6 Radiograph of a dentigerous cyst involving a maxillary canine tooth.

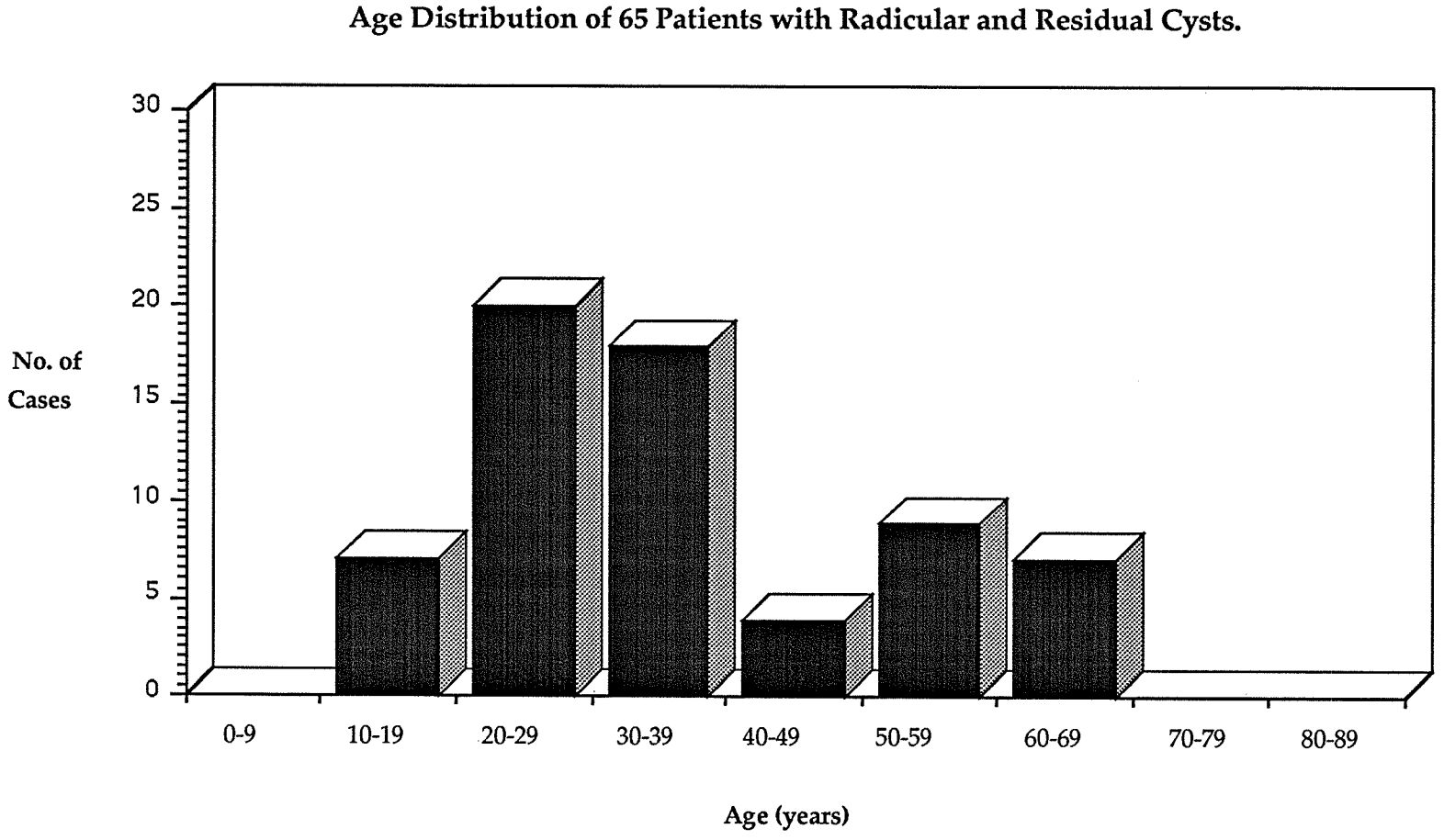
Age Distribution of 65 Patients with Radicular and Residual Cysts.
No. of Cases
30
25
20
15
10
5
0
0-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
Age (years)

Figure 17.7

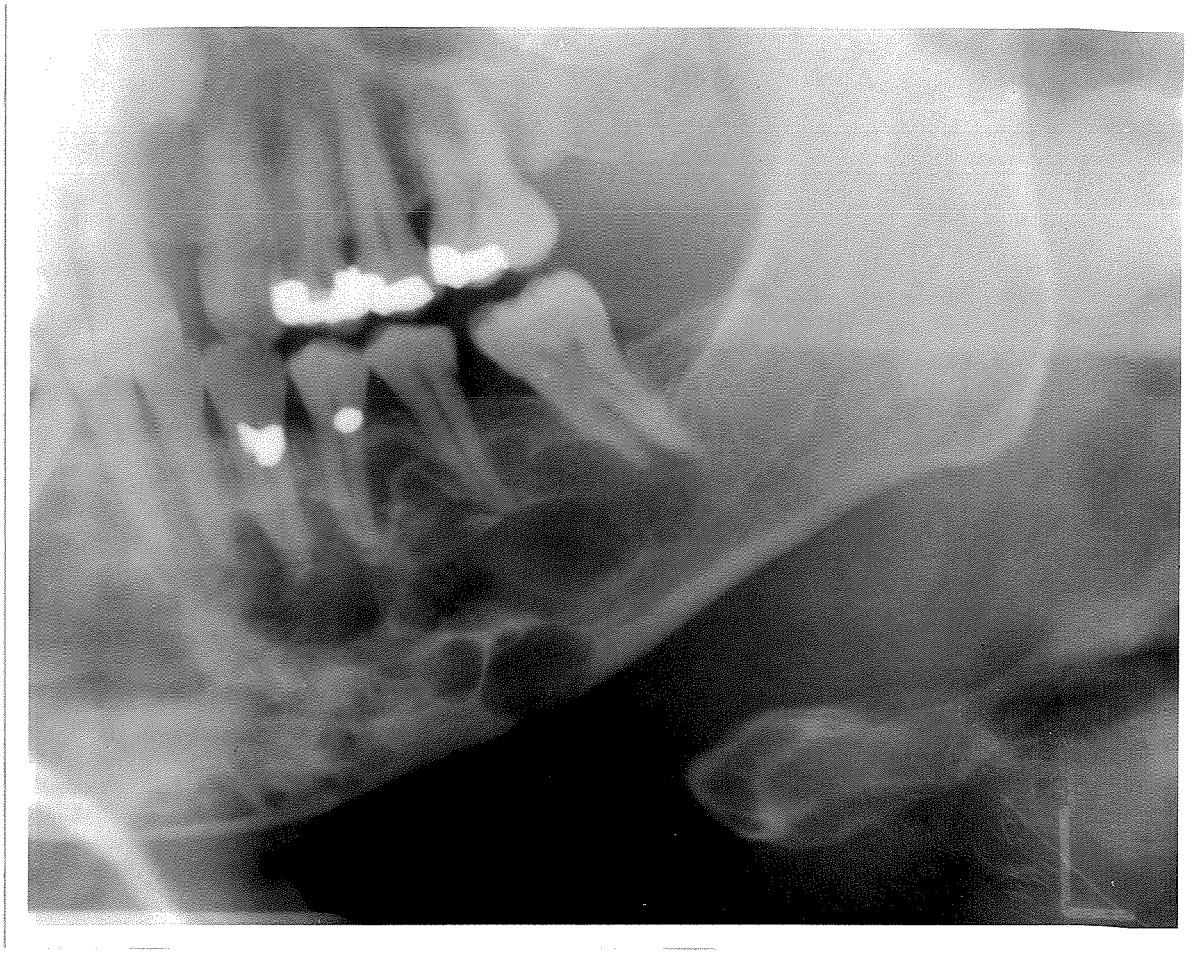

Figure 17.8 Radiograph of a multilocular keratocyst. The multilocularity was confirmed at operation.

Figure 17.9 Radiograph of a keratocyst showing involvement of the ascending ramus of the mandible.

Figure 17.10 Radiograph showing a recurrence of a keratocyst which was surgically removed five years previously.

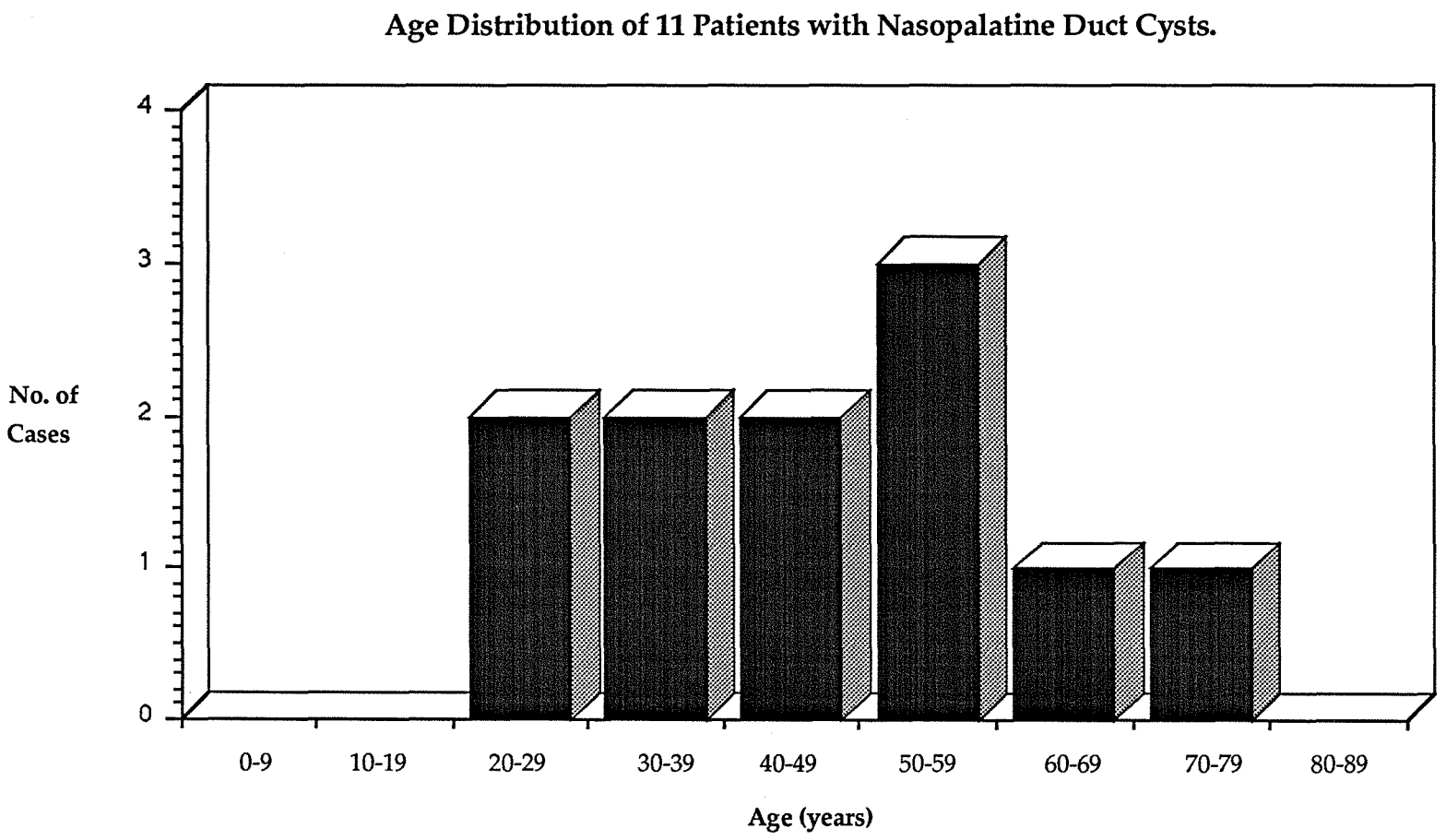
Age Distribution of 11 Patients with Nasopalatine Duct Cysts.
No. of Cases
4
3
2
1
0
0-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
80-89
Age (years)

Figure 17.11

The youngest patient was 6 years - an eruption cyst and the eldest seventy years - dentigerous, keratocyst and a nasopalatine duct cyst - Table 17.3.

TABLE 17.3

Age Distribution

Number of Cases of each Type

Age Group	Inflammatory	Keratocyst	Dentigerous	Eruption	Nasopalatine	Multiple
0- 9	-	-	1	2	-	-
10-19	7	1	4	-	-	-
20-29	20	2	5	-	2	3
30-39	18	1	4	-	2	-
40-49	4	1	2	-	2	-
50-59	9	3	2	-	3	-
60-69	7	-	1	-	1	1
70-79	-	1	1	-	1	-
80-89	-	-	-	-	-	-

c) Sex Distribution.

There is a slightly higher overall incidence of jaw cysts in males than in females - 58 and 42 per cent respectively. Most surveys of cysts of the jaws show a higher incidence of cysts occurring in males than in females.

Comparative Graph Showing Percentages of the Different Types of Cysts in Males and Females

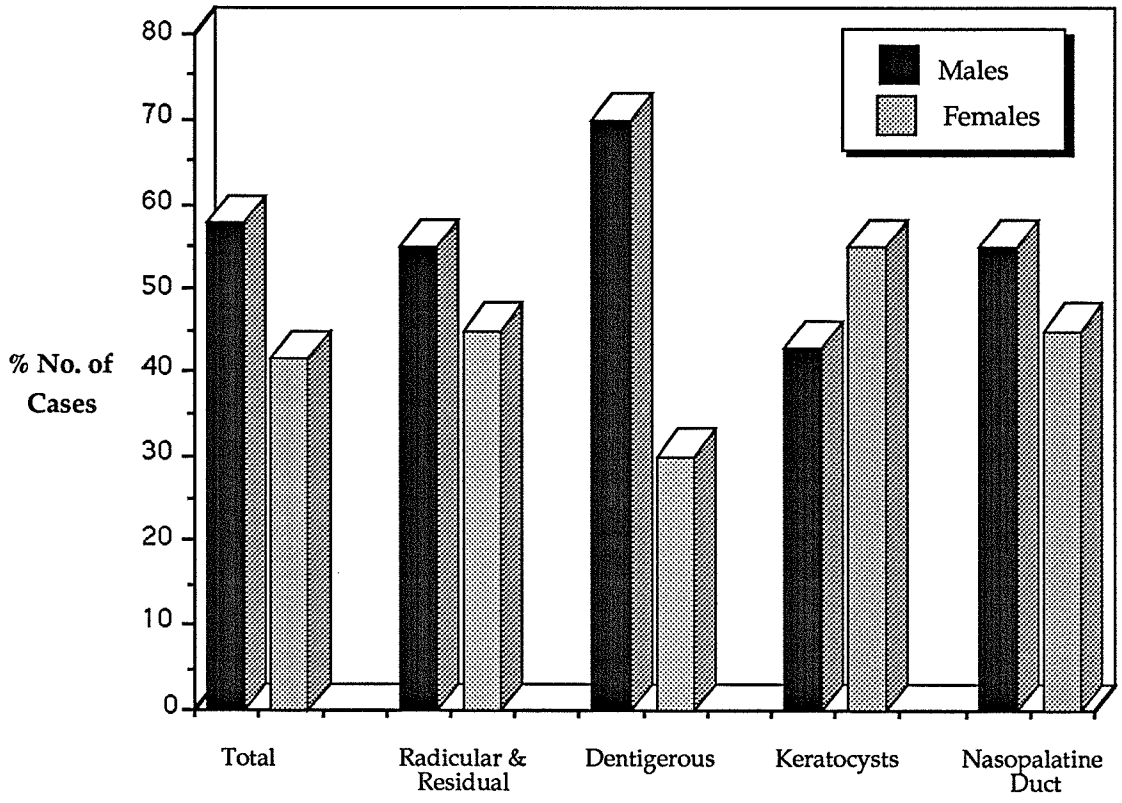

Figure 17.12

TABLE 17.4					
Sex Incidence in Individual Cases No of Cases of each Cyst Type					
Sex	Inflammatory	Keratocyst	Dentigerous	Nasopalatine	Multiple
Female	29	5	6	5	1
Male	36	4	14	6	3

d) Site Distribution.

The majority of cysts were situated in the upper jaw - 67 cases or 62.6 per cent occurring in the maxilla; in comparison 40 cases or 37.4 per cent were found in the mandible.

TABLE 17.5					
No of Cases of Each Cyst Type					
Position	Radicular	Residual	Keratocyst	Dentigerous	Non-odontogenic
Maxilla	40	7	3	4	11
Mandible	14	2	6	16	2

Of the inflammatory type of cyst the results showed that 65 per cent occurred in the maxilla, with the remaining 35 per cent being found in the mandible.

These results compare favourably with the results obtained by Cabrini et al[224]. Soames and Southam[226] claim that 60 per cent of cysts are found in the maxilla, where there is a particularly high incidence related to the anterior teeth. This is confirmed by Shear[89] who, in a study of 789 cysts noted that 60 per cent of the cysts were found in the maxilla. Staphne[227] and Mortensen et al[170] found the ratio of cysts in the maxilla to those in the mandible to be approximately 60 per cent and 40 per cent respectively.

The Upper Lateral Incisor Enigma.

Many workers have commented on the increased frequency of cysts in the anterior maxilla. Staphne[227], in his survey of 221 maxillary cysts found 54.3 per cent associated with the lateral incisor tooth. Mortensen and co-workers[170] reviewed 97 cysts of the maxilla and found only 24.8 per cent related to this tooth. In the survey carried out by Killey and Kay[122] approximately 60 per cent of the total number of cysts occurring in the anterior maxillary region were associated with the lateral incisor tooth. In the present study, of a total of 37 cysts which occurred in the anterior maxillary region 54 per cent were associated with the lateral incisor. In Shear's[89] study 37 per cent occurred in this region.

Fickling[41] reported that "of the cysts considered to have developed from a dead tooth present at the time of operation, 40 per cent were associated with the maxillary lateral incisor". Commenting on this high figure he continued "the high incidence of cysts of the lateral incisor is well appreciated, being related to the proximity of the coronal pulp to the surface,

the irritant properties of synthetic fillings, the frequency of invagination and the liability to death of the pulp from trauma".

Discussion.

One major disadvantage when carrying out such a clinicostatistical study is the relatively small 1 number of cysts studied. Another factor which may influence the results is that small cysts, such as radicular cysts, may not be referred to a hospital but treatment may be sought at a private clinic. There is no way of gathering information from private clinics so obviously this might influence the results obtained.

Another disadvantage is that no oral pathology laboratory is available; the histological specimens being examined by a general pathologist. Thus the "newer" type of cysts might be overlooked. This may be a reason why no paradental cysts were found; they may have been present but included as dentigerous cysts.

Notwithstanding these factors, the overall percentages of the various cyst types compare favourably with other larger statistical studies which have been carried out on cysts of the jaws. This can be seen from the various tables and figures included.

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